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To
Dr. Everett Herrick,
with assurance of the affectionate
regard of

Nov., 1896.

A MANUAL

OF

PHARMACOLOGY

AND

THERAPEUTICS

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BY

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REVISER'S PREFACE

THE original text being in a form most suitable for lectures (in which reiteration is often essential), some rearrangement of the matter has been made to avoid repetitions and to economize space. Several quotations from accessible authorities, and sections which interest, chiefly, British students, have been omitted. For the portions enclosed in brackets, the reviser is alone responsible. Articles embraced under the title "PREPARATIONS" are those of the Pharmacopœia of the United States of America. Customary doses have been incorporated with the index.

The increasing attention given to Climate and to Natural Mineral Waters, as therapeutical aids, has led to the insertion of additional matter taken from the writings of Arthur H. Nichols, M.D., of Boston, on Climate; and of George E. Walton, A.M., M.D., of Cincinnati, on Mineral Waters; neither of whom, as an eminent authority, requires present introduction.

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AUTHOR'S PREFACE

Pharmacology has of late attained such importance in the Medical Curriculum, that a Student's Text-book on the subject is urgently needed. This work is an abstract of the Lectures delivered at the Westminster Hospital during the current session, and is adapted primarily to the requirements of students preparing for the examinations.

The Therapeutical aspect of the question has been treated practically, and it is hoped that the large number of prescriptions scattered throughout the pages of the book will prove of use to practitioners who desire to keep abreast with the progress of modern treatment.

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INTRODUCTION

MOST of the modern works on Materia Medica deal only with drugs and their effects, simply as a matter of convenience. If we examine any of the older books on Materia Medica we find a great many things treated of that are now relegated to special treatises. Thus in the fourth edition of Pereira's work published in 1854, we find, in addition to the ordinary chapters on drugs, articles on such subjects as "Hope as a Therapeutic Agent"; "Monotony as a Means of Inducing Sleep"; "Light and Darkness"; "Hot and Cold Baths"; "Electricity, Magnetism, Mesmerism," and so on. Authors are not even agreed as to the proper limits of Therapeutics. In its broadest sense it embraces all known means of cure, even surgical operations; but by general consent we relegate to a distinct branch—that of surgery—the consideration of such questions as ligatures, amputations, excisions, etc., reserving to ourselves, however, the right to treat of such subjects as hypodermic injections, acupuncture, etc. It also comes within our province to discuss the treatment of disease by baths, packing, massage, and other similar means. We also deal with certain so-called systems of cure, such as the movement-cure; the koumiss-cure; the skim-milk treatment; the whey-cure; the grape-cure, and many others which need not be referred to in detail.

In former times many curious remedies were used in the treatment of disease. Thus the magi or priests of the

Persians, the wise men of the East, knew of herbs which, wrought into pills and swallowed in wine, would make the guilty confess their secrets. They had also an herb for begetting good and handsome children, and a wort to revive old love even when it had turned to hate. All these had magic names. They thought highly of the common mole, and taught that if any one swallowed its heart, palpitating and fresh, he would become an expert in divination. The heart of a hen, they said, placed upon a woman's left breast whilst she slept, would make her tell her secrets, if only her memory served her. The magi also taught to drink the ashes of a pig's pizzle in sweet wine, and so to make water into a dog's kennel, adding the words, "lest he like a hound should make urine in his own bed." If a man in the morning, they said, made water a little on his own foot, it would be a preservative against *mala medicamenta*, or drugs intended to do him harm.

Pliny mentioned many curious remedies. Thus, speaking of ague, he tells us how to cure it by amulets; by the dust in which a hawk has rolled; by the longest tooth of a black dog; by a solitary wasp caught in the left hand; by the head of a viper cut off and its living heart cut out and wrapped in a piece of cloth; by the snout and tips of the ears of a mouse, and so on.

Marcellus recommended, in order to avoid inflamed eyes, that when you see a star fall or cross the heavens you should count quickly, for you will be free from inflammation for as many years as you count numbers. If a man, he says, have a white spot or cataract in his eye, let him catch a fox alive, cut his tongue out, let him go, dry his tongue and tie it up in a red rag, finally hanging it round the neck. For toothache you are requested to spit in a frog's mouth and tell him to make off with it.

Ettmüller is conspicuous for recommending disagreeable and even revolting remedies, a prominent feature of his treatment being the employment of the excrement of various animals. Album canis or album græcum, in other words the "white of dogs," he recommended for bleeding and also as a gargle for sore throat.

In connection with the introduction during the last few years of testicular products and other extracts of animal origin as remedial agents, it is interesting to note that during the seventeenth century we find reproductive products, as obtained from mammals, birds, and fishes, enjoying a high reputation in the treatment of nervous derangements. They were generally employed to increase virility and to restore sexual vigor, many of them finding a prominent place in the London Pharmacopœia of 1676.

What drugs were first employed as medicinal agents it is difficult to say; but it is probable that the earliest inhabitants of the globe resorted to the use of water both for external and internal application, and were, in this sense, hydropaths. Charcoal, in the form of wood-ashes, naturally soon attracted attention, and its medicinal virtues must have been familiar to man from the most remote period of antiquity.

Sulphur or brimstone, which occurs so largely in volcanic regions, was known in the time of Moses and is mentioned in Genesis and also in the Iliad. The linseed or flax was cultivated in the earliest times and was well known to Pliny.

Many drugs now in daily use are mentioned by name or described in the Bible. For example, the "wild vine," referred to in the Old Testament, is supposed to be the plant known to us as colocynth. Its active purgative properties would fully justify the exclamation of the partakers of the pottage: "There is death in the pot!"

The spotted hemlock, or *Conium maculatum*, was the state poison of ancient Athens, and is generally supposed to have been the instrument of Socrates' death. Foxglove was not generally used in medicine until about the time of the Norman conquest. Broom was used in ancient Anglo-Saxon medicine, and under the name of *planta genista* has not failed to leave its mark on English history. Many of our most valued medicines—morphine, quinine, chloroform, ether, cocaine, pilocarpine, gelsemine, and a host of others—are products of the present century. Almost every day we witness the introduction of new remedies, some to supersede old-fashioned drugs, others to be used for a time and then cast aside in favor of more fortunate rivals.

SOURCES OF MEDICINES

Medicines are obtained from many and varied sources, all three kingdoms of nature being laid under contribution.

Some, such as sulphur and magnesia and the different salts of iron and mercury, are procured either directly or indirectly from the mineral kingdom; others, such as aconite, belladonna, and opium, come from the vegetable kingdom; while a few, such as cantharides, cod-liver oil, and pepsin, are furnished by animals. Many things, such as nitrite of amyl, nitroglycerin, and chloral, are organic compounds artificially prepared, and are not merely extracted from substances containing them. This source is daily increasing in importance, and it is not improbable that, in course of time, remedies prepared in this way will, to a very great extent, supersede the vegetable materia medica.

Drugs are imported from all quarters of the globe, almost every country, civilized or uncivilized, furnishing some useful contribution to the healing art. Senna is obtained from India; opium from Asia Minor, Egypt, and Persia; jaborandi from Pernambuco; jalap from Mexico; quassia from Jamaica; cinchona from the cloudy slopes of the Andes [and artificial plantations in India and Java], and ipecacuanha from Brazil; whilst the animal which yields musk is a native of the mountainous regions of Central Asia.

Fortunately some of our most valued and popular remedies are furnished by plants which grow at our very doors. Thus the well-known garden plant called monkshood, wolfsbane or blue rocket yields aconite; salicin is extracted from the common willow; digitalis is obtained from the foxglove, whose long, stately racemes of purple-colored flowers are the pride of many a garden. The leaves of the thorn apple or stramonium, when smoked in a pipe or cigarette, have relieved attacks of shortness of breath of many a chronic asthmatic, and the meadow-saffron or colchicum has proved a boon to many a gouty old gentleman.

[The following-named drugs are among those native to the United States: *Alnus rubra* or Tag alder; *Cerasus Virginiana* or Wild-cherry; *Frasera Carolinensis* or American Calumba; *Gelsemium sempervirens* or Yellow Jasmine; *Hamamelis Virginica* or Witchhazel; *Helonias dioïca* or False Unicorn-root; *Podophyllum peltatum* or May-apple; *Sanguinaria Canadensis* or Blood-root; *Scutellaria lateriflora* or Scullcap; *Spigelia Marylandica* or Pinkroot; and *Stillingia sylvatica* or Queen's root.]

ADULTERATION OF DRUGS

This is an interesting subject. Some people object to the term adulteration, and prefer calling it sophistication; but it amounts very much to the same thing, especially if you have paid for the pure drug. Adulteration (or sophistication) is the intentional addition to any article, for the purpose of gain or deception, of any substance the presence of which is not indicated by the name under which it is sold.

Deterioration is, of course, not the same as adulteration, but it belongs to the same family. It means those natural changes for the worse which take place in drugs as the result of age or exposure. Very many vegetable and other organic, as well as inorganic, combinations are susceptible to change under the influence of the atmosphere. It is well known that, under such conditions, a variety of deleterious products of chlorine are generated in chloroform. It has even been asserted that the emetic action which sometimes follows the hypodermic injection of morphine is due to the partial conversion of the alkaloid into apomorphine. The well-known variability of different specimens of ergot probably arises from the fact that ergot, unless carefully dried and packed in closely-sealed receptacles, soon loses its activity. Freshly-gathered pomegranate-root bark is a reliable anthelmintic; but, when dry and old, it acts as an emetic and intestinal irritant.

Substitution is the sale of one article in place of and under the name of another. As a rule collectors of crude vegetable drugs are but imperfectly acquainted with their botanical characters, and fail to distinguish accurately between allied species. It is asserted, on the authority of experts, that vegetable drugs, in themselves of indifferent activity, are from time to time found adulterated with belladonna leaves or hyoscyamus, in order to make them pass muster. Such additions, especially when in minute quantities, may easily escape detection, unless the examination is made with care.

In many cases the physical or chemical distinction between good and bad drugs is difficult, and sometimes impossible of determination.

The activity of a drug often depends on its habitat. The respective commercial values of different varieties of opium, aloes, and colocynth, for example, depend very much on the country in which they are grown. While one or two grains of Socotrine aloes will induce a comfortable evacuation of the bowels, a similar effect cannot be produced with any certainty from five times this dose of Arabian or Moka aloes. Digitalis grown on the hills is much more active than the foxglove which grows in valleys or is cultivated. English [and American] hemp are quite different in physiological action from the hemp grown in tropical climates, which yields hashish.

The season of the year at which a plant is gathered notably affects its medicinal activity. For example, digitalis, especially the mountain digitalis, gathered on mountain ranges of Central Germany, is much more active when the plant is in full bloom and at the acme of its vigor. The corm and seeds of colchicum yield a much larger percentage of colchicine when the plant is in full bloom than at other periods of the year. The juice of *Ecballium Elaterium* or squirting cucumber yields from four to five-per cent. of elaterin when collected in July, whilst in September it is almost entirely destitute of this principle. Extract of hyoscyamus, made from the dried leaves, contains very little alkaloid, whilst an extract made from fresh leaves yields a considerable percentage.

[It is reported that the practice is not uncommon to defer the sale of roots of *Convallaria majalis* (or lily-of-the-valley) until after the flowering season, by which time all their medicinal properties have vanished.]

No difficulty is experienced in getting drugs of good quality if the purchaser is prepared to pay a reasonable price for them. If you go to a "cutting chemist" you naturally expect to get a drug of poor quality. It cannot be too generally known that any drug can be obtained at almost any price—in name, at all events. The vender simply adds so much inert material as will enable him to obtain the same profit as if he sold the genuine article. The chemist is not to blame; it is the system (sometimes adopted in hospitals and dispensaries) of accepting the lowest tender for drugs, which is at fault.

Powdered drugs are commonly of inferior quality for two reasons: First, because inferior and less sightly portions of the plant are employed in their preparation; and, secondly, because the facilities for adulteration are great. It is often found that powders are offered at the price of, or at an inadequate advance upon the cost of, the crude drug, notwithstanding the loss which of necessity results from powdering and drying.

Many pharmaceutical preparations, as ordinarily purchased, are not in accordance with the requirements of the Pharmacopœia. Tinctures vary materially in character and quality, and there is reason to believe that many tinctures are systematically prepared of light weight, both as regards drug and menstruum, in order that they may be sold at a lower price.

Some years ago Prof. C. Lewis Diehl, of Louisville, Ky., issued a report on "Deteriorations, Adulterations, and Substitutions of Drugs,"[1] in which he gave a list of roots which had at different times been examined by competent authorities. It was found that much of the aconite root sold was tasteless, and had evidently been first exhausted and then redried. Of three packages of arnica, one contained fifty-per cent. of the true root, another only ten per cent., whilst the third contained none at all. Sarsaparilla was found to be adulterated with nut-galls, ipecacuanha, matico stems, paper, bark, straw, and bay-leaves. The common adulterants of ground pepper are pepper-leaves, sage, rape-seed, potato, spices, capsicum, chicory, rye, bone-dust, and dirt.

All the highly-priced drugs are special objects of adulteration. Quinine was at one time systematically sophisticated. In one instance finely picked cotton was added in order to increase the bulk; in another the specimen consisted almost entirely of salicin; whilst a large consignment of "sulphate of quinine" sent out to India contained not a trace of any of the cinchona alkaloids.

Even when drugs are not actually adulterated they not uncommonly vary enormously in strength and activity. We have a good example of this in the case of pepsin. Some time ago I had occasion to examine a number of specimens of pepsin, and, as the selection included nearly all the recognized brands, the results are not without interest. Estimation of the comparative value of different preparations of pepsin, although simple in theory, is by no means easy in practice, especially if accuracy is desired. The essential action of pepsin is proteolytic—the conversion of proteids into peptones—and this is usually taken as the test of the value of the specimen.

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[1] [Supplement No. 6, National Board of Health Bulletin: 1879.]

Thirteen solid specimens of pepsin were examined, some of English, others of French, German, or American manufacture. They were all active, but in many the proteolytic power was very small. Only four came up to the standard of the British Pharmacopœia. The name is evidently no guarantee of purity, for a specimen made by a well-known firm was represented by the figure 871, while another, sold under an equally well-known name, had to be satisfied with an award of 162—a state of affairs which is hardly satisfactory. In addition to the thirteen solid pepsins, I examined six liquid preparations—wines, essences, etc. The results were unsatisfactory, and the conclusion was that they were not very reliable, although none of them were absolutely inactive. The same pepsin is often sold under different names, according to the amount of impurity added.

Having used the *Carica papaya* largely in the treatment of various forms of dyspepsia, I determined to try it against the best pepsins, but found that, under the same conditions, it was decidedly inferior in activity. I examined, in all, six specimens of papaw, but only two would come up to the Pharmacopœia test for pepsin. The best papain had about half the activity of the best pepsin. I do not say that in alkaline or neutral media the papains are not more active; but simply that, tested against the best pepsins and by the same methods, they do not give equally good results. Even in a neutral solution the best papain was not equal to the best pepsin in an acid solution. A papaw preparation which, in a certain time, dissolved 420 grains in an acid solution, dissolved 476 grains in a quarter per cent carbonate of sodium solution and 535 grains in a neutral solution.

Another investigation had for its object the comparative values of different extracts of malt in the market, with reference to their power of converting starch into glucose.

Eleven specimens were tried, and although some were extremely active, others were absolutely destitute of diastasic properties. One specimen, which had been supplied in large quantities to a hospital for more than two years, was perfectly valueless. It was dark in color and had clearly been prepared at a high temperature. The money wasted on this single drug would have sufficed to pay a skilled pharmacist, whose technical skill would have been a sufficient guarantee against so serious an error.

As another example of the enormous difference in the activity of different specimens or different preparations of the same drug, I may quote my experience of *Grindelia robusta* in the treatment of asthma. My first experiment was made with a sample sent me by a well-known firm of American chemists. It was in every way perfectly satisfactory and afforded my patient enormous relief. My supply being exhausted, the dispenser obtained a quantity from a firm of druggists in the City. This was a failure and did little or no good. A specimen was then procured from another English firm; but this, although distinctly better, was a long way behind the American sample. Finally a supply was sent over by the American firm, and this, although much better than the specimens obtained in England, was not up to the standard of their sample. The observations were made on the same patient; she was tested time after time without being informed of the change in the source of the remedy, but she never failed to detect the substitution.

Every drug should, in hospital practice, be tested chemically by the dispenser and therapeutically by the physician, either in the wards or out-patient room. It is not at all uncommon to come across medicines which are wholly inoperative. This is not always the fault of the wholesale chemist; for it must be remembered that he has no opportunity of witnessing the effect of the medicines, and if no complaint is made he naturally assumes that they are active.

THE STUDY OF MATERIA MEDICA

Most students get up their materia medica by learning it straight out of a text-book. Treated in this way it is not by any means an inviting subject, and a student poring over a Pharmacopœia is not a picture of contentment. A far better plan is to discard the book and work at the specimens themselves. A description from actual observation is always more to the point than a formal definition. Students who come up for examination often make use of long words without understanding very clearly what they mean. Such terms as "efflorescence," "deliquescence," and "fluorescence" are scattered about in reckless profusion and without any particular regard for the consequences. A student on one occasion stated that bicarbonate of soda was "efflorescent," and, on being asked to explain the word, gave the botanical definition, evidently without recognizing the fact that it was hardly appropriate. The real way to study materia medica is to take a specimen and describe it in your own fashion.

GENERAL APPEARANCE.—In the first place you note its appearance. It may be liquid, like bromine, chloroform, ether, or cod-liver oil; or it may be solid. If it is solid it may be in masses like bark, or it may be in crystals like sulphate of potassium. The shape of masses or crystals should be described. If it is a powder it may be amorphous like carbonate of bismuth, or crystalline like sulphate of quinine.

COLOR.—Next its color should be noted. It may be black like charcoal, yellow like sublimed sulphur, red like the biniodide of mercury, or gray like gray powder.

WEIGHT.—Then its weight should be noted. It may be heavy like litharge or the salts of mercury, or it may be light like magnesia or cotton.

ODOR.—Next its odor is of importance. Smells are difficult to describe, but there are certain terms which are pretty generally recognized. Thus we say that bromine has a disagreeable acrid odor; ammonia, a pungent odor; alcohol, a spirituous odor; sweet spirit of nitre, a fruity odor; nitrite of amyl, an odor like jargonelle pears, and so on. There are many drugs which can be readily recognized by the smell alone—ammonia, acetic acid, prussic acid, chloroform, ether, bromine, iodoform, carbolic acid, creasote, musk, sumbul, and a host of others.

TASTE.—Then the taste has to be described. A substance may be sweet like sugar, or extract of malt; or it may be acid like hydrochloric acid, or vinegar; alkaline like carbonate of potassium; bitter like sulphate of quinine, or colocynth; acrid like liquor potassæ; saline like common salt, saltpetre, or sal-ammoniac; pungent like mustard, horseradish, capsicum, or peppermint; or it may be astringent like catechu, or kino; aromatic like cinnamon; styptic like perchloride of iron; metallic like perchloride of mercury, and so on. These are not nearly all the terms used in describing the different varieties of taste; there are many more. Sometimes combinations of terms are employed; thus permanganate of potassium is said to have a taste which is "sweet, astringent, and somewhat mawkish."

AFFINITY FOR WATER.—Next to taste comes affinity for water, and this, in many cases, is a matter of considerable importance. Some drugs take up water readily and if exposed to the air, for even a short time, become "deliquescent." A good example of this is afforded by acetate of potassium. If exposed to the air it liquefies, so that it is usually kept in tightly stoppered bottles. Other drugs are "efflorescent"; that is, they part with their water of crystallization and become white and powdery on the surface. This is seen in the case of carbonate of sodium and some other salts.

EFFECT OF HEAT is worth noting. Some drugs burn readily, as, for example, phosphorus (which, unless kept in water, is apt to catch fire spontaneously) and the hypophosphites of lime and sodium. Others are volatilized by heat, as, for example, iodine, which gives off violet fumes when exposed to sunlight. Others remain fixed and unaltered, like charcoal; others, again, are fusible, like sulphur.

CHEMICAL TESTS.—In many cases it is desirable to test the drug with reagents. Tests would be applied, in the case of a salt, first for its base and then for the acid.

PHARMACOLOGICAL INVESTIGATION

An attempt will be made in this section to give a rough idea of the general lines followed by a pharmacologist in investigating the action of an unknown drug.

There are two methods—the clinical and the physiological—by which the actions of medicinal and other agents can be investigated. By the clinical method observations are made on men and animals in a state of disease with a view to cure the diseased condition, whereas, by the physiological method, experiments are made on healthy animals with the view of determining the action of the modifying agent on a body not rendered abnormal by the incidence of disease. The clinical method is as old as medicine itself, but physiological investigation is of comparatively recent date and has become necessary from the limitations of clinical observations. Every experiment with a drug on a healthy organism is merely auxiliary to its employment in the cure of disease and for the alleviation of suffering.

As a rule the uninvestigated, crude drug is sent to us by some traveller or explorer, or possibly by a doctor practising in some tropical district. The consignment is usually accompanied by a statement or memorandum giving the native name or names of the drug, and a brief description of the mode in which it is employed. It may be stated, for example, that the drug is prepared by the priests or by the chiefs of a tribe and used as an arrow-poison; or there may be a statement to the effect that it is employed as an ordeal poison for the detection of crime; or possibly we may be told that the leaves are made into a tea and that, when administered in cases of snake bite or fever, it produces profuse perspiration or perspiration and salivation. Sometimes the rough effect of the drug on animals has been noted, and we are told that when birds eat the berries they drop down dead, and cattle grazing in the fields where the plant grows become paralyzed.

Sometimes attention is directed to a drug by cases of poisoning. For example, a consignment of beans is brought from Africa and, there being no known use for them, they are cast on the quay, where they attract the attention of a crowd of school boys, who eat them and are taken to a hospital, where certain symptoms are noticed and recorded for publication. Sometimes something more specific is asserted and we are told that the drug is a positive remedy for consumption or cancer. These are examples of the kind of history we get with samples of new drugs.

The first step is to endeavor to ascertain the botanical origin of the plant. Even if the genus and species cannot be determined, the natural order will present no difficulty and may afford a useful clue. For example, if the drug belongs to the *Solanaceæ* or to the *Loganiaceæ* we know pretty well what to expect.

The next step is to make the plant into a tincture or fluid extract. We first make a preparation of the whole drug and then of the leaves and root separately. The pharmacologist then tries it on himself, commencing with a very small dose, and, day by day, increasing it until some definite symptom is noticed. The symptoms are carefully recorded, and, if they are severe, the pharmacologist or his fellow-workers will have an opportunity of trying various antidotes. Should the drug kill the pharmacologist the post-mortem appearances will be noted. If no action results from a large dose, the drug is presumably inert and the investigation comes to an end.

In the event of symptoms indicating an active drug an attempt will be made to extract an alkaloid or active principle. Probably the alkaloid will yield salts soluble in water, and this solution, in various strengths, is used in subsequent investigations.

The pharmacologist drops some of the solution into his eye and notes the effect on the pupil. It may dilate it, or contract it ; or it may produce anæsthesia, or intense inflammation.

When the investigator has recovered from the effects of this observation he proceeds to inject himself hypodermically with various doses of the alkaloid, again noting the symptoms.

After this he feels justified in giving a frog a small injection hypodermically, with the view of ascertaining the general effect on the animal.

Subsequently he piths a frog and, after opening the pericardium, applies a few drops of the solution to the heart, noting whether it produces any irregularity in the ventricular contraction and, if the heart ceases to beat, whether it is arrested in systole or in diastole. The effect of other drugs in restoring its action is observed, and the influence of the drug in antagonizing the effect of muscarine on the heart is investigated.

These preliminary experiments will throw some light on the general action of the drug, and a good idea will be formed as to the class of remedies to which it belongs and as to the system on which it primarily acts. After this the investigation will branch off in various directions, according to the indications obtained. It need hardly be said that even the simplest experiments of this kind cannot be carried out by unskilled observers. It requires experience ; takes up a great deal of time ; involves a considerable expenditure of money, and the only reward is unlimited abuse.

The organs of cold-blooded vertebrates (especially the frog) are best adapted for pharmacological investigation, because they, equally with those of mammals, are susceptible to the action of poisons and may be isolated from the rest of the body without impairment of function. For example, experiments may be made on the isolated heart of the frog or on nerve-muscle preparations. Again, by tying blood-vessels, the action of the drug may be confined to one particular extremity, or, on the other hand, that particular limb may alone be exempt from the action of the poison. There are certain peculiarities in frogs which have to be carefully studied. There are various species and at different seasons of the year different effects may be induced.

Observations on ciliary motion are amongst the simplest with which we have to deal. A frog, after being pithed, is placed on its back and the lower jaw removed, so as to render readily accessible the mucous membrane covering the palate and upper part of the pharynx, parts which are abundantly covered with ciliated epithelium. A fragment of sealing-wax, not bigger than a pin's-head, is attached to an ultimate fibre of silk and suspended in such a manner that it only just comes in contact with the ciliated mucous membrane, the greater part of its weight being supported by the thread. The cilia, acting on the sealing-wax, cause it to move gradually downwards towards the lower part of the pharynx. Two pins are then fixed in the mucous membrane, about an inch apart, and the time taken by the float to traverse the distance between them is noted by a metronome beating seconds. Undue evaporation is prevented by surrounding the animal with moist blotting-paper, and the mucous membrane itself is wetted, at fixed intervals, with a definite quantity of normal saline-solution. When the average time taken to run the course has been determined with sufficient accuracy, the drug, dissolved in the saline-solution, is applied and the effects are noted. In an observation with pilocarpine the normal duration of the transit was found to be 64 seconds. The average of observations taken every five minutes, during the first quarter of an hour after the application of the drug, was 79 seconds; in the next quarter, 104 seconds; and in the next, 180 seconds. On washing away the drug with normal saline-solution the rate improved, in twenty-five minutes, from 600 to 155 seconds. This is a very simple form of experimentation, but is useful for class-demonstration when no apparatus is available.

The action of drugs on the voluntary muscles of cold-blooded animals can be investigated in various ways. It is not, as a rule, a good plan to apply the drug directly to the muscle substance, or to immerse the muscle in a solution of the drug, for nearly all solvents, even "normal saline," exert some influence on the muscle structure. If, however, the drug is a gas, or can be obtained in the form of a vapor, the mode of procedure is simple and it is easy enough to improvise an apparatus. A wide-mouth bottle is furnished with a tightly-fitting cork, perforated so as to admit two glass tubes, one of which, for pumping in the gas, dips under a layer of water at the bottom of the bottle, the other, for the escape of the gas, being shorter. A fine wire, passing through the cork, supports one end of the muscle by the tendon or bone and serves as one electrode, while a fine, spiral wire, attached to the other extremity of the muscle and also passing through the cork, serves as the other electrode. As the gas acts only on the superficial fibres of the muscle, a long, thin muscle such as the sartorius of the frog is selected. The object of passing the gas through water at the bottom of the bottle is to keep the air moist and prevent the muscle from drying. In the majority of cases, however, this method is not available and the drug is administered to the frog hypodermically. When the poison has had sufficient time to act the animal is pithed and the muscle, with its motor nerve, is excised for investigation.

The results will, of course, have to be checked by an investigation of the condition of an unpoisoned muscle taken from the same animal. This presents no difficulty, for when the gastrocnemius with the sciatic nerve is selected the corresponding structures of the opposite limb can be protected, prior to the administration of the poison, by ligature of the common iliac or of the femoral artery on that side. There is, however, a fallacy to be guarded against in this experiment, for some substances (the potash salts, for example) are capable of becoming diffused through tissues shut off from the circulation, almost as rapidly as when the blood-supply has not been interfered with. When ligature of the femoral artery produces no modification in the condition of the muscle, as compared with the poisoned muscle on the other side, the tissues which are supposed to be protected must be tested for the presence of the drug, to make sure that there has been no diffusion.

The action of drugs on motor nerves is of importance only with regard to their power of transmitting motor impulses to the muscles in which they terminate, and the same methods of investigation are employed as in the latter case.

To determine the local sensory action of a drug the method introduced by Dr. Thos. J. Mays, of Philadelphia, may be adopted: Five or six drops of a one- or two-per cent. solution of the drug should be dropped, either from a dropper or from a hypodermic syringe, into one nostril of a frog, at intervals of from three to five minutes, the nasal reflex being tested by introducing the end of a very fine wire into the nostril under the influence of the drug, and also into the nostril on the opposite side. As soon as the wire comes in contact with the inner surface of the untreated nostril, the frog will make an effort to brush away the irritant with the front foot, while, after the instillation of a drug having anæsthetic properties, the reflex action on that side is abolished. In this way it has been shown that brucine, curarine, hydrastine, and many other drugs possess local anæsthetic properties.

The action of drugs on the frog's heart may be determined by observations on that organ *in situ*, the pericardium having previously been slit open. The movements may be recorded graphically by means of the "frog-heart lever"—a simple rod of light wood, balanced on knife-edges set in steel supports. Observations may also be made on the extirpated heart, and, if care is taken, in cutting through the cardiac vessels, not to injure the sinus venosus, the heart will continue beating, in a watch-glass containing normal saline-solution, for many hours. For supplying an artificial circulating fluid to the interior of a frog's heart, a Kronecker's perfusion cannula may be employed, and this, if adapted to a Roy's tonometer, will record changes in the volume of the ventricle or auricles. The "circulating fluid" is made as follows: Take 99 cc. of 0.6 per cent. chloride of sodium solution, saturate it with phosphate of lime, and add 1 cc. of a one-per cent. solution of chloride of potassium.

Satisfactory results, both as to the rapidity of the heart's pulsations and its relation to various conditions of the vascular system, may be obtained in warm-blooded animals by Marey's or Pond's sphygmograph applied over an artery; by the cardiograph, over the cardiac impulse; or by Ludwig's or Fick's manometer connected with an artery and registering the oscillations of blood-pressure. The best form of cardiograph is that of Marey and Chauveau, as modified by Burdon-Sanderson.

The action of drugs and other agents on different organs may be investigated by means of the oncometer and other similar instruments. To take Roy's renal oncometer as an example: The kidney is enclosed in a metal box filled with warm oil, the box being so constructed that no oil can leak out, while the structures at the hilus of the organ are not injuriously pressed on, the vessels, ureter, and nerves being carefully protected. This is effected by the oncometer being made of two precisely similar parts, each half having a piece of peritoneum applied to it in such manner that the space between the membrane and the wall of the oncometer can be filled with oil. The membrane, being flexible, applies itself accurately to the kidney, so that the organ is practically in the same position as a heart enclosed in the pericardium full of fluid. The heart corresponds to the kidney, and the visceral layer of the pericardium to the delicate membrane of the oncometer, the pericardial sac finding its equivalent in the oncometer, and the pericardial fluid in the oil filling the instrument. If the oil in the oncometer is placed in communication with a recording apparatus, we have an oncograph, by which any expansion of the kidney can be recorded in the usual manner. If we record, simultaneously, the general blood-pressure ; the expansion and contraction of the kidney, and the excretion of urine, we have the means of determining the action of any drug or agent in a very complete manner.

There are many different kinds of oncometers—such, for example, as the heart-oncometer. The apparatus is readily modified so as to adapt it for observations on the spleen or the intestine, or on the foot of a dog, cat, or rabbit.

The word oncometer (ὄγκος (*ongkos*)=volume) was introduced by Roy, and we speak of an arrangement of this kind with its recording apparatus as an "oncograph." For estimating and registering the amount of blood in a limb the apparatus devised by Mosso and known as the plethysmograph is commonly employed.

In making observations on the influence of drugs in promoting or retarding the secretion of bile, Rutherford's method is usually adopted. Through an opening in the linea alba a glass cannula is inserted into the common bile-duct, near its junction with the duodenum. To the end of the cannula (which projects from the abdomen) a short india rubber tube is attached, terminating in another glass tube having a narrow aperture, through which the bile can exude in drops. The gall-bladder is compressed, in order to fill the tube with bile, and the cystic duct is then clamped, to prevent return of bile to the gall-bladder and to compel all bile secreted to flow through the cannula. The bile is collected in a fine, cubic-centimetre measure, the quantity being read off every quarter of an hour. The drug, the action of which is being investigated, is injected by means of a small syringe into the duodenum, from which it is rapidly absorbed. This is a great improvement on Röhrig's method of working with permanent fistulæ, and collecting the bile either in a bag attached to the cannula or by means of a sponge placed in a tin box secured to the abdomen.

It does not fall within the scope of this book to describe all forms of apparatus employed in pharmacological investigation. For further details the student is referred to the third edition of Stirling's "Practical Physiology," and to Stewart's excellent "Manual of Physiology" (1895). The latter contains a series of practical exercises which will be found of much value to the pharmacologist.

PHYSIOLOGICAL ACTION

It is difficult to lay down rules for describing the physiological action[1] of a drug; but by taking the different structures and organs of the body systematically, it is not likely that anything of importance will be omitted.

A practical acquaintance with the effects produced by various drugs is of importance, not only to the therapeutist, but to the specialist in forensic medicine. A poison may be present in such small quantities that it cannot be detected by chemical tests, although its physiological actions may amply suffice to determine its nature. In more than one instance physiological tests have been the main instruments in securing a conviction for murder. Such was the case of Dr. de la Pommerais, who, in Paris, in 1864, insured the life of a woman named Pauw for 550,000 fr., and then gave her digitalin, from the effects of which she died. No poison was detected in the body by chemical analysis; but it was shown in evidence that shortly before her death the deceased had vomited on the floor. A spirituous extract was made of scrapings of the wood and of the substance deposited between the planks. A few grains of this extract were injected into a dog, which soon suffered from vomiting and depression of the heart's action, and died in twenty-two hours. Similar effects were produced in a rabbit, and on this evidence the prisoner was convicted and executed.

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[1] [So-called by virtue of custom; but the definition of "Physiology" as "The science which brings together, in a systematic form, the phenomena which normally present themselves during the existence of living beings" (W. B. Carpenter) can hardly be considered to consistently include the derangement of natural functions produced by drugs or by the removal of portions of the body from their normal relations to other parts.—F. A. C.]

In the celebrated Lamson case, tried in 1882, physiological experiments were made with an extract prepared from contents of the stomach of the deceased. When this was given hypodermically to mice the symptoms observed were found to be identical with those following the administration of aconitine, and on this evidence, mainly, conviction was secured.

Some drugs produce a very definite effect when applied to the skin. Mustard, for example, gives rise to redness and burning, cantharides blisters, while the vapor of chloroform or ammonia, when confined, acts as a powerful irritant. Other drugs act on the mucous membrane—as, for example, aconite, which produces numbness and tingling in the mouth, throat, and adjacent parts.

Some drugs, inhaled in the form of fine powder, produce persistent sneezing, and we have examples of sternutatories (or errhines, as they are called) in casca bark; in powdered quillaia bark and saponin; in ipecacuanha, colocynth, and in veratrine.

Some drugs act on the blood or on some one of its constituents; iron, for example, and the nitrites.

Some drugs act on the blood-vessels, altering, in some way, their calibre; nitrite of amyl, nitroglycerin, and ergot are such.

Then there are drugs which act upon different parts of the nervous system—opium on the brain; picrotoxin on the medulla; strychnine and physostigmine on the cord;

coniine and curare on the motor nerves, and aconitine and cocaine on the sensory nerves.

The following-named drugs act on the cord and produce tetanus :

Nux vomica, strychnine, brucine.
Thebaine.
Belladonna, hyoscyamus, stramonium.
Atropine, homatropine, hyoscyamine.
Calabarine.

The belladonna group produces what is called "late tetanus"—that is, tetanus which comes on as the primary paralysis is passing off.

The chief depressants or paralyzers of the cord are :

Physostigma, physostigmine, or eserine.
Chloral hydrate, paraldehyde.
Bromides of potassium, sodium, ammonium, and strontium.

Other drugs act on muscles—either on the voluntary or involuntary muscular system, and, as examples, ergot, nux vomica, veratrine, and phosphorus may be mentioned. The action of ergot in parturition, in arresting post-partum hæmorrhage and other forms of bleeding, is the result of its power of stimulating muscular tissue. The benefit derived from belladonna in incontinence of urine, and from belladonna and nux vomica in the treatment of habitual constipation, are other examples of this power. The influence of veratrine on the muscle-curve is a common class-demonstration, while the action of phosphorus and salts of vanadium, in inducing fatty degeneration of muscular tissue, is well known.

Certain drugs, taken into the stomach, act as emetics. Some act topically or locally, while others are absorbed into the circulation and affect the vomiting-centre. Mustard, alum, and salt are examples of local emetics, while apomorphine is the best representative of the second division. Some drugs (such as sulphate of zinc and tartar emetic) probably act both as general and local emetics.

Many drugs act as sedatives to the mucous membrane of the stomach, and this group includes the salts of bismuth, dilute hydrocyanic acid, oxalate of cerium, and creasote.

Of stomachic stimulants or carminatives we have examples in oil of cajuput, terebene, pinol, eucalyptol, and capsicum.

The stomachic tonics or bitters are gentian, calumba, quassia, chiretta, cusparia, and, also, strychnine and quinine.

Pepsin and other ferments are digestive agents which serve to disintegrate food and render it ready for absorption when there is a deficiency of natural gastric juice.

Many drugs affect the bile-secreting or bile-expelling apparatus. Podophyllin resin is a hepatic as well as an intestinal stimulant. Both euonymin and iridin powerfully stimulate the liver, while they exert but very little action on the intestine. Sulphate of sodium is a hepatic stimulant, while sulphate of magnesium exerts no such action—a point of considerable importance in the selection of a natural purgative water.

Opium and morphine, although commonly employed to check diarrhœa, exert their influence on the intestinal movements and secretions only, and, contrary to the generally-accepted opinion, do not affect biliary secretion. Acetate of lead, especially in large doses, is a direct hepatic depressant and is, probably, the only drug which possesses this effect without producing purgation. Drugs which exert a purgative effect by their action on the intestine not infrequently check the secretion of bile. Clinical observation in these cases is often fallacious, and we have to rely almost entirely on carefully-conducted pharmacological experiments.

Many drugs exert an influence on the kidneys and either directly or indirectly alter the quantity, appearance, and composition of urine. Some drugs increase the amount of water, urea, or uric acid excreted, while others diminish them. Diuretics produce their effects in various ways, such as by acting on the circulation and by raising the pressure in the glomeruli, or by acting directly on the excreting cells of the tubules.

Some drugs—such as the carbonates and bicarbonates of potassium, sodium, and lithium—render urine alkaline, while benzoic acid and the compound tincture of benzoin, from the facility with which they yield hippuric acid, are useful in keeping up the acid reaction.

Many drugs alter the color of urine. For example : Carbolic acid, salicylic acid, and resorcin turn it black or nearly so ; rhubarb stains it yellow ; santonin produces a yellow color if the urine is acid, and a blood red if alkaline.

Phosphorus, turpentine, and terebene impart an odor of violets to urine, while the effect of asparagus in this relation is well known. Some drugs—such as cantharides and turpentine—produce hæmaturia and albuminuria, while after the inhalation of nitrite of amyl, ether, or chloroform, glycosuria is not infrequently observed.

A few drugs exert an action on the bladder without affecting the kidneys excepting, perhaps, indirectly. Pilocarpine causes contraction of the muscular wall of the bladder, and many drugs may be classed as vesical sedatives or vesical alteratives. Cubebs, copaiba, and oil of sandalwood are valued for their action on the mucous membrane of the urethra.

Some drugs appear to exert an action on the sexual organism. For example, strychnine, phosphorus, cantharides, and damiana are said to be aphrodisiacs, while the bromides are undoubtedly anaphrodisiacs. Some drugs—such as permanganate of potassium, binoxide of manganese, and senecio—have a distinct emmenagogue action, while ergot, savin, rue, pennyroyal, and powdered bitter apple are supposed to be ecbolics and are popularly employed as abortifacients.

Many drugs exert a special action on the eye, either by altering the size of the pupil ; by interfering with the power of accommodation ; by increasing or diminishing intraocular pressure, or by stimulating the sensitiveness of the retina. Those which dilate the pupil are known as mydriatics, and those which contract the pupil, as myotics.

General anæsthetics contract the pupils during the early stage, but may subsequently dilate them. Gelsemium produces ptosis and double vision. Cocaine is used for its local anæsthetic properties on the conjunctiva and deeper structures.

Many drugs, in process of elimination by the skin, produce certain effects. The secretion of sweat is increased by jaborandi, pilocarpine and pilocarpidine; by muscarine, physostigmine and picrotoxin, and, to slighter degree, by antimony, Dover's powder and acetate of ammonium. Jaborandi and pilocarpine also promote the growth of hair, and are employed for this purpose.

Drugs which dry the skin by arresting secretion are belladonna, atropine and homatropine, hyoscyamus and hyoscyamine, stramonium and the two secondary or antagonistic alkaloids of jaborandi—jaborine and jaboridine. Oxide of zinc, tannin, and some other astringents exert a somewhat similar effect, although they commonly fall within a different category.

It will be seen that, as a rule, drugs which contract the pupils are sudorifics or diaphoretics, while the pupil-dilators are anhydrotics. There is, practically, no difference between a diaphoretic and a sudorific; but the term "diaphoretic" is used when the secretion is only slightly increased and evaporates as fast as it is formed, while a "sudorific" is something which increases the sweat to such quantity that it pours off the skin in drops. It is, therefore, a distinction of no practical importance.

Many drugs are eliminated wholly or in part by the skin, and, in process of elimination, produce rashes of various kinds. For examples:

Bromides cause acne, chiefly on the face and back.

Iodides also produce acne and, less commonly, petechiæ all over the body.

Tar causes acne.

Belladonna, hyoscyamus and hyoscyamine, stramonium, atropine and homatropine produce an erythema like the rash of scarlet-fever.

Chloral hydrate causes erythema.

Antipyrin produces erythema, chiefly on the thighs and abdomen, attended with much itching.

Copaiba, cubebs, and salicylic acid cause urticaria, or a rash like that of measles.

Arsenic and mercury produce eczema.

Morphine injected hypodermically sometimes produces a rash, and, in exceptional cases, a rash may follow the administration of quinine, guaiacum, or *Hydrastis Canadensis.*

Antidiphtheritic serum often produces a rash, accompanied by pains in the joints. The dried serum less frequently has this effect than serum employed in liquid form.

Long-continued administration of nitrate of silver produces permanent discoloration of the skin.

Croton oil, antimony, and sulphur produce a rash when applied externally.

The eruption produced by the inunction of antimonial ointment resembles that of small-pox. At first there is simple redness accompanied by burning pain. This is followed by the appearance of a number of small papules, which soon become converted into vesicles and then into pustules, irregular in shape and size and varying from an eighth of an inch to an inch and a-half in diameter. In cases of poisoning by tartar emetic, a rash of this description sometimes appears all over the body.

The eruption produced by local application of croton oil to the skin is at first papular; but the spots soon assume the form of pustules, some of which are rounded and some flattened and umbilicated, with a red areola.

Sulphur, applied locally, produces red, rough, erythematous patches, which may ultimately assume the form of eczema.

Some drugs produce itching, and the pruritus of opium is well known. In a case of poisoning by codeine irritation of the skin lasted for many days.

Students often experience great difficulty in remembering what preparations of a drug are official, but a very good guess can generally be made from a consideration of the physiological action. If, for example, a drug is valued for its action on the skin or subjacent tissues, there will, in all probability, be a liniment, ointment, or plaster. If the drug is a throat-remedy there will naturally be a gargle or lozenge, or some equivalent preparation. The physical characters and solubility of the drug will also afford some indication of the form in which it is likely to be prescribed.

There can be no doubt that a relationship exists between chemical constitution and physiological action, and the properties of an alkaloid, with regard to its action on the body, may be altered by modifying its chemical composition. For much of our information on this subject we are indebted to the researches of Prof. T. R. Fraser and Dr. A. Crum Brown. They prepared from strychnine the iodide of methyl-strychnine. The difference in the composition of these substances is slight, strychnine being represented by the formula $C_{21}H_{22}N_2O_2$, while iodide of methyl-strychnine is $C_{21}H_{22}N_2O_2CH_3I$. The difference in pharmacological action of these bodies is very great. In none of Fraser's experiments—not even in fatal cases—were symptoms of tetanus induced by the methyl-derivates of strychnine. In fact a condition exactly the reverse of that produced by strychnine followed the administration of the compound. In place of violent, spasmodic contractions and muscular rigidity, there was a perfectly flaccid condition of the muscles.

There is a striking resemblance between the action of methyl-derivatives of strychnine and that of curare. The special characteristic of curare-poisoning is that it produces paralysis by an impairment or destruction of the function of the peripheral terminations of motor nerves. Experiments show that methyl-strychnine derivates produce paralysis and death by destroying the function of motor nerve end-organs, and that the mode of action is identical with that of curare. It is remarkable that, by so simple a chemical process, the physiological action of a drug should be so completely changed.

By the addition of iodide or sulphate of methyl the action of brucine can be changed. Brucine acts as a kind of mild strychnine and is a convulsant poison, producing death either by exhaustion or by asphyxia. Its methyl-derivatives never produce convulsions, and, although they cause death by asphyxia, this asphyxia, in place of being the result of prolonged and continuous muscular action (due to abnormal nerve activity), is the result of muscular paralysis resulting from partial or complete absence of normal nerve activity.

Thebaine—one of the alkaloids of opium—is a tetanizer, although somewhat inferior in power to brucine. The chief physiological action of the methyl-derivates of thebaine is an impairment and, finally, a destruction of the functions of the peripheral terminations of the motor nerves—an action as unlike as can be the effects produced by thebaine itself.

Experiments with codeine—another opium alkaloid—show that its action is completely altered by its conversion into methyl-codeine.

Sulphate of methyl-morphine is a paralyzing agent, the paralysis being due to an effect on motor nerves.

The physiological action of nicotine, atropine, and coniine may be modified or altered in much the same way.

Another curious example of the change which occurs in physiological action is afforded by the conversion of morphine into apomorphine. The only chemical difference is that morphine loses a molecule of water.

$$\begin{array}{ll}
\text{Morphine,} & C_{17}H_{19}NO_3 \\
\text{Water,} & \quad H_2\ \ O \\
\hline
\text{Apomorphine,} & C_{17}H_{17}NO_2
\end{array}$$

Morphine is a narcotic and relieves pain; apomorphine has neither of these actions, but is a powerful emetic and expectorant.

When cocaine is heated in a watery solution a methyl group is replaced by hydrogen. The benzol-ecgonin which is formed differs completely, in physiological action, from cocaine, and no longer paralyzes the sensory nerves.

The influence of chemical composition in the case of aniline and some of its derivatives is well marked. Aniline itself ($C_6H_5NH_2$) dangerously depresses the nervous system; lowers temperature and, by its action on hæmoglobin, produces cyanosis. By replacing one of the atoms of H by acetyl (C_2H_3O), acetanilide or antifebrin is formed—a substance which, if not free from objection, at all events possesses useful antipyretic and analgesic properties. Its toxicity is much less than that of aniline, although not infrequently it produces cyanosis and other disagreeable effects. If we replace one atom of H in acetanilide by the radical OC_2H_5, we get phenacetin, possessing the antipyretic and analgesic effects of acetanilide with still less of the aniline action. None of these drugs are perfect, but perhaps, by-and-by, we may get hold of something which will relieve pain without producing untoward effects.

IDIOSYNCRASY

Some people are peculiarly susceptible to the action of certain drugs, in much the same way that some are unusually affected by certain articles of diet. Such was the case of a hospital patient who stated that he was violently affected after eating even the smallest quantity of mutton. The house-physician, disbelieving his statement, had some mutton made up into pills and ordered one to be taken three times a day. Immediately after taking the first pill the patient was seized with diarrhœa and vomiting which persisted for some hours.

The following instance is related on the authority of the late Dr. Roupell. A relative of his could not partake of rice in even the most minute quantity without experiencing most distressing symptoms. Some friends, wishing to test the truth of this supposed idiosyncrasy and knowing that he was fond of biscuits, had some made containing one grain of rice in each. They were placed near him at dinner and he partook of two or three. He became uncomfortable and had to leave the table, remarking, at the same time, that if he were not morally certain that he had eaten no rice, he could have sworn that he was suffering from the effects of it.

Mr. George Pollock tells of a man who could not eat gooseberries without their producing an eczematous eruption all over the body. Dining-out one night he was induced to taste a special brand of champagne. A few minutes later, turning to his host, he remarked that the wine was not champagne at all, but was made of gooseberries; and, pulling up his shirt-sleeve, showed the specific eczematous rash as a proof of the correctness of his statement. I have recorded the case of a man who could drink, practically, any amount of red-wine or spirits, but who was reduced to a condition of collapse by a single glass of champagne.

Some people cannot take certain kinds of fish without suffering acutely, and numerous instances have been recorded of people who have suffered severely from urticaria after eating strawberries.

Singers sometimes lose their voices after being in a room with flowers which have a powerful odor; and there are people who become asthmatic after smelling violets, wall-flowers, or privet.

The existence of an idiosyncrasy with respect to drugs is well established. The majority of people can take five grains of iodide of potassium without suffering any inconvenience; but there are individuals who cannot take even a single grain without exhibiting the symptoms of coryza, accompanied by gastric catarrh and intense mental depression. Susceptibility to bromides is not so common; but there are people who cannot take half a dozen doses without getting a well-marked acne rash all over the face and body. When the patient is epileptic this is a serious matter; for either he is unpresentable on account of his spotty condition, or he is afraid to go out because of the liability to an occurrence of the fits. A few years ago a new bromide—bromide of strontium—was introduced, which was said never to produce an eruption. I tried it in many cases with good results, but then there came a patient in whom it produced acne, and it was clear that the strontium salt had no advantage over its congeners.

Some people cannot take quinine, even in the smallest dose, without getting singing in the ears, while others are equally susceptible to the action of iron.

Many people either will not or cannot take narcotics. Of course there is a good deal of fancy in these cases, and many a patient who says he cannot take opium takes compound soap-pills without difficulty; just as patients who say they are peculiarly susceptible to arsenic make no objection when they find they are taking Fowler's solution.

Some time ago I ordered apomorphine for a lady as an expectorant. She read the prescription, and the next day informed me that the medicine had made her so drowsy that she was unable to keep her eyes open. I endeavored to explain to her that apomorphine had none of the properties of morphine, but she remained unconvinced.

That many people are susceptible to the action of powdered ipecacuanha is well established. It usually produces coryza and then a sharp attack of dyspnœa. This has been tested over and over again, and there is no doubt about the fact. Powdered colocynth—which is largely employed for keeping furs free from moth—has a similar effect.

These idiosyncrasies with respect to the action of drugs are not easy to explain. The untoward effects produced are not always identical with the toxic action of the drug. It is not always the case that a patient is peculiarly susceptible to the drug, but that, in certain individuals, symptoms are produced which are not observed in others. It is probable that in many cases the idiosyncrasy is temporary rather than permanent, and that it may be the result of, or, at all events, associated with, certain other conditions which aid in its production. For example, the action of calomel is said to differ according to the amount of salt in the system, and it is asserted that when patients are kept on a low diet, almost free from salt, calomel exerts very little action; but that when given to people who have been fed on salt meat (sailors, for instance), it acts as a violent, gastro-intestinal irritant. This may not be exactly a case of idiosyncrasy, but it shows that the condition of the body influences its susceptibility to the action of drugs.[1]

TOLERANCE AND HABIT

Toleration with respect to certain drugs is very easily established. The story is told of a man who established tolerance in the case of so many drugs that when he wished to commit suicide he could find no poison which would affect him.

The most familiar example of toleration is afforded by tobacco. The experiences of a novice in the art of smoking are by no means pleasurable. He vomits; is purged; suffers from distressing giddiness; is deadly pale; his pulse is weak and thready, and the whole body is covered with a cold, clammy sweat; yet in few days, or a few weeks at the outside, he becomes so habituated to use of the drug that he can smoke all day without inconvenience. Very often tolerance is not complete, for the habitual cigarette-smoker may be made decidedly uncomfortable by a cigar or pipe. Even in the matter of cigarettes there is a difference, for the man who smokes "Virginia Straight-cut" cigarettes to the tune of twenty or thirty a day may be upset by a single Egyptian cigarette. The explanation may be that some Egyptian cigarettes contain a small quantity of *Cannabis Indica*, or the tobacco may have been grown on ground on which the poppy had previously been planted. Some people smoke with comfort and enjoyment only after meals or after taking alcohol; they find that they cannot smoke after drinking tea, and it is a common experience that tobacco goes well with coffee and badly with tea.

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[1] [When salt is present in the stomach or intestine, calomel is apt to take up another equivalent of chlorine and become a bichloride. The presence, also, of acids favors this change; therefore, abstinence, for the time, as regards both, is advisable, and it may be well to guard the calomel by adding some bicarbonate of sodium. The formation, in this way, of even a small amount of corrosive sublimate would readily account for the gastro-intestinal disturbance.]

Another familiar example of tolerance is afforded by alcohol. A person who is a total abstainer may be made decidedly uncomfortable by "tipsy cake," whereas there are many men who will put away a couple of bottles of champagne without inconvenience. Many habitual topers are so accustomed to the use of the drug that they never get drunk. They may be muddled, or heavy and sleepy, but they know perfectly well what they are doing and are quite able to execute delicate manipulations to which they are accustomed, with ease and accuracy. For example, a soubrette may delight her audience with her singing, and may even dance, when she is so drunk that she can hardly stand. A steeple-jack will go up a two hundred-feet ladder with ease when he cannot walk straight on level ground.

Tolerance is soon established in the case of coffee. Many people, if they are not accustomed to it, suffer from wakefulness on first taking black-coffee after dinner. Soon, however, this susceptibility passes off, and after a few days they take it with impunity. If, however, they abandon the custom, they experience the same difficulty on resuming it. Many people who can take ordinary coffee are kept awake by "special-coffee" which is extra strong.

The best example of tolerance is afforded by people who, from long habit, are accustomed to take large doses of opium. They soon get habituated to its use and take it with the view of inducing its primary or stimulating effects. In the case of De Quincey this stage usually lasted about eight hours and he was enabled to time the exhibition of his dose so that its narcotic influence corresponded to the natural hours of rest. Not infrequently he indulged in an opium debauch before going out to dinner or preparatory to visiting the opera. This, however, was not always the case, and, in common with most opium-eaters, he resorted to the drug when he could enjoy its effect in perfect quiet. We have another example of tolerance in the arsenic-eaters of Styria. They begin with a small dose, and gradually increase the quantity as they become accustomed to its effects. The tolerance, however, is not permanent, for if an arsenic eater leaves his native country and abandons the habit he cannot resume it with impunity on his return.

It is said that, in some cases, tolerance has been established for corrosive sublimate and that there are people who can take very large doses with impunity.

A very good example is connected with the use of sulphate of zinc. Ordinarily this salt acts as an emetic and thirty grains will promptly evacuate the stomach. In many nervous diseases, such as chorea, large doses may, however, be given with advantage, and, if the quantity is gradually worked up to, as much as twenty grains may be given every two hours without producing nausea or inconvenience of any kind.

Tolerance is quickly established in the use of conium, and, if the dose is gradually pushed, patients will commonly take enormous doses of the succus without the induction of its ordinary physiological effect. With care even an ounce may be given hourly with safety.[1]

ACCUMULATION

Some drugs are said to be cumulative, and what is generally understood by this expression is, that the patient goes on taking a certain medicine up to a particular point, when, quite suddenly, he suffers from untoward symptoms. This is true to a certain extent, but it is not the whole truth. Digitalis being commonly quoted as an example of a cumulative drug, what happens is this : Digitalis is a diuretic and is eliminated with the urine. While the patient is taking it he may catch a cold, or meet with some disturbance of the system which leads to an interference with the action of the kidneys. The drug is no longer eliminated, and the result is that a larger percentage than usual is present in the blood and produces toxic symptoms.

We get pretty much the same thing in chronic lead-poisoning : The poison circulates slowly, becoming assimilated and eliminated in nearly equal quantities, until an increase in the dose ; arrest of elimination ; an affection of the kidneys ; weakening of vital powers, or, possibly, exhaustion of tolerance by the animal economy, or all of these combined, allow the phenomena of acute or chronic lead-poisoning suddenly to declare themselves.

INCOMPATIBILITY AND ANTAGONISM

Incompatibility may be either chemical or physiological. It is easy to give examples of the former variety. A student being told to prescribe for a patient suffering from dyspepsia, writes out a formula for a gentian and acid mixture containing fifteen minims of dilute hydrochloric acid in each dose. The patient mentions, casually, that she is "troubled with the wind," and the student, knowing that sal-volatile is "good for flatulence," adds half a drachm of the aromatic spirit of ammonia to each dose, regardless of the fact that the hydrochloric acid neutralizes the ammonia

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[1] [In the United States, succus conii has been declared by many authorities to be extremely variable as regards the strength of different samples. It should, therefore, be given with caution when a fresh supply is used.]

Chemists are very fond of telling us that certain combinations are incompatible, although, in reality, they are not so [as regards their therapeutical effect]. For example, we are constantly warned not to give iron with vegetable infusions containing tannin, "because they are incompatible." As a matter of fact they are not. The tannic acid combines with the iron to form tannate of iron, which is black and consequently makes an unsightly mixture ; but, therapeutically, it is active enough and is readily absorbed by the stomach. Thus a prescription which would be rejected on purely chemical grounds may be therapeutically active. For example, an injection might be ordered containing acetate of lead and sulphate of zinc with rose-water. It is true that the sulphate of lead formed by the double decomposition would be precipitated; but this finely-divided acetate of lead, when shaken up, would form a very valuable application in a case of gonorrhœa.

Some combinations of drugs are explosive. For example, chlorate of potassium and gallic acid, ordered to be dispensed in powder for the patient to dissolve in water, to form a gargle, exploded violently and resulted in a serious accident to the pharmacist. A mixture of chlorate of potassium, tincture of perchloride of iron, and glycerin exploded when kept in a warm place. Chromic acid readily parts with its oxygen and explodes when mixed with glycerin. Oil of turpentine and sulphuric acid explode violently when mixed. Amber-oil, for the same reason, should not be dispensed with nitric acid. It is not wise to prescribe oxide of silver or nitrate of silver with creasote in the form of a pill. Permanganate of potassium and glycerin form a dangerous combination, and it is not safe to prescribe the former in a pill with extract of gentian, or the whole mass may go off suddenly. The proper excipient in this case is kaolin or porcelain clay. A simple example of an explosive combination is afforded by putting a few chlorate of potassium tablets and a box of parlor-matches into an overcoat pocket.

Antipyrin gives us two good examples of incompatibility. When mixed with spirit of nitrous ether it forms green crystals, and with salicylate of sodium, an oily liquid. Chloral is decomposed by alkalies and should not be given with liquor potassæ or with ammonia.

There are certain mixtures which, although not incompatible, are inexpedient. No one, for example, should prescribe tincture of capsicum in an effervescing mixture, for the patient, in taking a dose, will be in danger of being half-blinded by the hot pepper.

Physiological incompatibility is of much greater importance, and, curiously enough, it is a subject to which but little attention is paid, for it is very common to come across prescriptions containing drugs absolutely antagonistic in action. For example, pilocarpine will not produce sweating if administered with atropine. No student who knows pharmacology is likely to fall into the error of prescribing things which are physiologically incompatible.

Sometimes, however, a prescription is bad on both chemical and pharmacological grounds. For example, strychnine with bromide of potassium is bad, for these two are physiologically antagonistic. But it is worse chemically, for after a few hours an insoluble bromide is formed which settles to the bottom of the bottle, so that a patient gets the whole of it with the last dose, the bromide being sufficient in quantity to form a chemical compound with the strychnine, but not to counteract its powerful physiological action. We have a similar example when acetate of morphine is prescribed with bicarbonate of potassium or carbonate of ammonium.

There was at one time considerable difference of opinion as to whether drugs could be mutually antagonistic. The opponents of the theory of mutual antagonism maintained that while one drug increases, another depresses or suspends function, and that the drug which increases function can never overcome the effect of a drug that has abolished function. The advocates of the theory of mutual antagonism pointed out that atropine will antagonize the action of muscarine, and muscarine the action of atropine on the heart; that atropine will antagonize the action of pilocarpine on the submaxillary gland, and *vice versa*, and that, moreover, if, after atropine has antagonized the effects of pilocarpine, a further quantity of pilocarpine is administered, it will overcome the action of the atropine, and salivary secretion will be re-established; and, finally, that lime and potash (which excite the same action on the frog's ventricle when administered simultaneously) do not produce the sum of their united action, but one drug lessens the effect of the other. The weight of evidence is clearly in favor of the latter view, and we are justified in assuming the existence of mutual antagonism between certain drugs. If further evidence were required it is afforded by the fact that in experiments with Roy's apparatus, when the ventricle only is employed, chloroform and ammonia are found to be mutually antagonistic. Iodoform and ammonia are also mutually antagonistic with regard to their action on the whole ventricle.

It is not difficult to find examples of physiological antagonism:

Nux Vomica Strychnine Brucine Thebaine Calabarine	Antagonize the effect of	Physostigma Physostigmine Chloral Hydr. Paraldehyde Bromides	on the cord.

Belladonna Hyoscyamus Stramonium Atropine Homatropine Hyoscyamine Duboisine Jaborine Jaboridine	Antagonize the effect of	Jaborandi Pilocarpine Pilocarpidine Muscarine Picrotoxin	with respect to secretions.
		Aconite Aconitine Muscarine	on the heart.
		Opium Morphine Codeine	as regards general action, but only partly.
Digitalis		Aconite Aconitine	on the heart.

ACTIVE PRINCIPLES

A great number of plants contain active principles, some of which are alkaloids and some are not.

Alkaloids are mostly formed in the tissues of plants or animals, but some are prepared synthetically.

The name alkaloid is derived from *alkali* and εἶδος (*eidos*) =likeness. As regards nomenclature, the distinctive mark of an alkaloid is the termination *ine*.

Alkaloids are analogues of ammonia, being, in reality, ammonia in which one, or perhaps more, of the atoms of hydrogen is replaced by a radical. They usually contain nitrogen, carbon, and hydrogen, and this class are, chemically, amides. In a few alkaloids there is no oxygen. These are, chemically, amines. Although, as a rule, solid, when they contain no oxygen they are oily liquids. Examples of the former are morphine, quinine, atropine, strychnine, and apomorphine. The principal liquid alkaloids are nicotine, coniine, pilocarpine, and jaborine.

With the exception of codeine and brucine, alkaloids are insoluble in water, but all dissolve in alcohol. They have an alkaline reaction and readily combine with acids to form salts, which are readily soluble in water. Most alkaloids have a powerful physiological action.

Vegetable alkaloids are precipitated from solutions by what are known as "alkaloidal group-reagents." These are:

Wagner's Reagent, prepared by dissolving iodine in a solution of iodide of potassium. Sonnenschein's Reagent, prepared by dissolving phosphomolybdate of sodium in ten times its weight of water and adding one-tenth of its volume of strong nitric acid. Mayer's Reagent, made by adding a solution of potassium-iodide to a solution of mercuric-chloride, until the red precipitate, at first thrown down, is redissolved in the excess of potassium-iodide; Scheibler's Reagent, which is phospho-tungstic acid.

Some alkaloids are precipitated by all these reagents; others by one or more of them.

The first alkaloid extracted was morphine. Its discovery is due to Friedrich Wilhelm Adam Sertürner, an apothecary of Eimbeck, in Hanover. He had been engaged for eleven years in a study of the chemical composition of opium, and, in 1816, announced that a substance which he had discovered, in addition to possessing a well-marked alkaline reaction, was capable of uniting with acids to form salts. He even hazarded the conjecture that it was closely allied to ammonia. His observations attracted much attention, and many of the better-known toxic and medicinal plants were submitted to chemical analysis, the result being the discovery, within sixteen years of the appearance of Sertürner's work, of strychnine, brucine, quinine, and cinchonine by Pelletier and his associate Caventou; of narcotine and codeine by Robiquet; of veratrine by Meissner; of coniine by Gisecke; of atropine by Mein; of nicotine by Reimann and Posselt; and of aconitine and hyoscyamine by Geiger and Hesse.

It is by no means an easy matter to extract an alkaloid from a plant and it is not particularly easy to recognize it when it is obtained. If it be an alkaloid or alkaloidal salt it will, when heated to redness, completely burn away. When mixed with caustic soda and lime and heated, it will evolve the odor of ammonia. A solution of one of its soluble salts will give a precipitate with tannic acid, picric acid, chloride of gold, iodide of potassium and mercury, and with various other substances which are known to precipitate alkaloids. Apart from its chemical reactions, its physiological properties may throw some light on the subject. Care must be taken not to mistake a salt of ammonium for a salt of an alkaloid.

It is well known that several so-called alkaloids are, in reality, mixtures of other alkaloids. For example, daturine is a mixture of atropine and hyoscyamine. An alkaloid which has been obtained from different sources, and investigated by different observers, may be known by two or more different names. For example, duboisine is identical with hyoscyamine, and pituri (the alkaloid of *Duboisia Hopwoodii*) is identical with nicotine.

Many plants contain more than one alkaloid, and it often happens that the second alkaloid has, practically, the same physiological action as the first, but is weaker—morphine and codeine, strychnine and brucine, for examples. Sometimes the two alkaloids contained in a plant are antagonistic in action. For example, physostigma contains physostigmine (or eserine) and calabarine. Physostigmine paralyzes the spinal cord, while calabarine acts like strychnine and stimulates it. In the same way jaborandi contains two alkaloids—pilocarpine which produces sweating and salivation, and jaborine which acts like atropine as it checks sweating and dries the mouth. In some cases there are two pairs of alkaloids—a stronger and a weaker having one action, and another pair, one strong and the other weak, antagonistic in action to the first pair. Some alkaloids, curiously enough, always run in couples; for example, strychnine and brucine are always found together.

That one alkaloid can be made from another is well known. Morphine and apomorphine are a case in point. It is well known, too, that by altering the chemical constitution of an alkaloid its physiological action can be completely changed. This subject is referred to in the section on physiological action.

Ptomaines.—During decomposition of animal matters, substances are formed which are known by the generic title of ptomaïnes, and which closely resemble some of the vegetable alkaloids, not only in chemical characters, but in physiological properties. They are commonly produced in animal substances exposed to the air after having been, for some time, excluded from it, being found in corpses which have been exhumed, and also in potted meats and canned foods only partly consumed the day they were opened.

So far back as 1822 Gaspard and Hick extracted a toxic principle from corpses. In 1866 my colleague, Dr. Dupré, found in the liver an alkaloidal principle resembling, in many of its properties, quinine. In 1868 Bergmann and Schmiedeberg obtained from putrid beer the nitrogenous, crystalline substance then known as sepsine. Creatinine was discovered in urine by Liebig and Pettenkoffer. Luff gives a list of the principal ptomaïnes which have been extracted from putrefying animal matters and submitted to ultimate analysis. From putrefying horse-flesh and mackerel we get collidine ($C_8H_{11}N$), parvoline ($C_9H_{13}N$), and hydrocollidine ($C_{10}H_{15}N$). From human corpses we get putrescine ($C_4H_{12}N_2$), neuridine ($C_5H_{14}N_2$), cadaverine ($C_5H_{14}N_2$), neurine ($C_5H_{13}NO$), and choline ($C_5H_{15}NO_2$). Gadinine ($C_7H_{17}NO_2$) is obtained from putrid codfish.

Creatinine ($C_4H_7N_3O$) from urine; sarkine [or hypoxanthine] ($C_5H_4N_4O$) from urine and flesh; carnine ($C_7H_8N_4O_3$) from fresh meat, and guanine ($C_5H_5N_5O$) from guano, belong to a class of these substances called leucomaïnes. Some of both classes are active poisons, and it is not at all improbable that, in a few years, they will be used as therapeutic agents. Instead of prescribing calomel or compound rhubarb pill, we shall give minute doses of one or another ptomaïne.

Certain ptomaïnes have given rise to many cases of poisoning, sometimes on a large scale. In suspected poisoning, when an alkaloid is detected in the exhumed body, a common defence now is that the symptoms observed were due to cadaveric alkaloids, and not to a vegetable poison. Dr. Stevenson was cross-examined on these lines in the celebrated Lamson case, tried in 1882.[1]

Glucosides or Neutral Principles resemble alkaloids in having a powerful physiological action and in representing the activity of the plants from which they are derived. It is characteristic of a glucoside that, when heated with a dilute mineral acid and water, it yields glucose as one of the products of decomposition. The other product formed differs in character from the original glucoside. Thus salicin, when boiled with dilute sulphuric acid, splits up into dextro-glucose and a body known as saligenin.

As regards nomenclature, it should be noted that the names of neutral principles end in *in*, and not in *ine* as in the case of alkaloids—*e.g.*, aloïn, salicin, santonin, and picrotoxin.

Ergotin is not an active principle, but is a purified extract of ergot. Chrysarobin is a mixture containing chrysarobin, chrysophanic acid, and other substances.

In addition, we have a number of so-called active principles which are, in reality, resinoids made by adding a concentrated fluid-extract of the drug to a large quantity of water. To this group belong baptisin, cimicifugin, euonymin, gelsemin, hamamelin, helonin, hydrastin, phytolaccin, sanguinarin, and senecin.

SERUM THERAPEUTICS

Of late there has been an enormous development in the use of animal products as therapeutical agents. This new departure was, to a great extent, the result of Brown-Séquard's observations with orchitic fluid. His account may not have been strictly accurate and his statements were undoubtedly considerably exaggerated ; but, for all that, the credit is due to him of having drawn prominent attention to a subject of considerable interest and importance.

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[1] [For further details consult "Ptomaïnes and Leucomaïnes, or the Putrefactive and Physiological Alkaloids," by Prof. Victor C. Vaughan.]

Organic sterilized fluids have been largely employed, chiefly in the form of injections, in the treatment of many diseases. Orchitic or testicular fluid has been recommended in senile mental debility and in the treatment of locomotor ataxy. Cerebrin—the fluid extracted from gray matter of the brain—is said to be useful as a nerve-tonic and in neurasthenia. A renal extract has been suggested as a cure for Bright's disease. The fluid of the pancreas has been employed in diabetes. Preparations of the thyroid gland have been used with much success in myxœdema, obesity, and psoriasis. Supra-renal fluid has been given in Addison's disease. An extract of the medulla of bone has been found useful in persistent anæmia and leucocythæmia. Muscular fluid has been recommended in muscular atrophy. Many of these are merely in the stage of suggestion, and their value is unsupported by good clinical evidence. Another animal product—the tuberculin, of Koch—although it has failed to answer the expectations formed of it as a curative agent, is useful for diagnostic purposes. The discovery of this substance, even if it has not cured patients suffering from phthisis, has placed in the hands of veterinary surgeons a weapon by means of which animals may be freed from tuberculosis at a cost absurdly small, compared with the steady loss entailed by present neglect of every reasonable precaution against inevitable spread of the disease.

The greatest advance in the use of animal products for treatment of disease was the introduction of antitoxin. The results of the injection into patients suffering from diphtheria, of the blood-serum of animals artificially immunized against the disease, achieved by Behring and his colleagues in the hospitals of Berlin and other places in Germany, and by Roux and Martin in Paris, were brought prominently before the International Congress of Hygiene, at Budapest, in September, 1894.

The fact that a variety of toxins—such as the diphtheria and tetanus toxins, abrin, ricin, and snake venom—when administered to animals in repeated, non-fatal, but gradually increasing doses, imparts to them a high degree of resistance; and that the blood of such animals acquires specific powers, so that its serum can be used as a therapeutic agent, is now well established. From a scientific point of view the value of antitoxic serum rests on a firm basis, and the clinical evidence in its favor, obtained from all quarters of the globe, is overwhelming. Since the introduction of the dried anti-diphtheritic serum, this mode of treatment has advanced steadily in professional favor. The antitoxin of tetanus and the antitoxin of glanders have been equally well received and there is reason to hope that, before long, all diseases of bacillary origin will be treated by antitoxins. The researches of Professor Fraser, of Edinburgh, have placed us in possession of antivenene, a substance derived from animals protected against serpent-venom, and have practically solved the difficulties so long experienced in finding a reliable remedy for snake-bite. Serum therapeutics now holds an established position and we may reasonably anticipate still greater developments in this direction.

The recent researches of Schäfer and Oliver have thrown considerable light on the mode of action of one or two important animal products. They find that extract of thyroid gland produces a distinct action on blood-vessels, so that blood-pressure falls to a very notable extent, although the beats of the heart remain at about the same rate and of the same strength. This effect is evidently due to an increased calibre of the blood-vessels.

The extract obtained from supra-renal bodies has an entirely different action. The medulla of the supra-renal capsule contains a dialyzable, organic principle, soluble in water, and not destroyed by boiling for a short time. It has a powerful physiological action on the muscular system in general, especially on skeletal muscles, the muscular walls of blood-vessels, and the muscular structure of the heart. Some action is also manifested on certain nerve-centres in the bulb, especially the cardio-inhibitory centre and, to a small extent, on the respiratory centre. The effect on a skeletal muscle is to greatly prolong the contraction resulting from a single excitation of its nerve—an action comparable with that produced by veratrine.

The action on the heart and on the arterial system is well marked. When the vagi are uncut, and the heart is, therefore, still in connection with the cardio-inhibitory centre in the medulla-oblongata, the action of supra-renal extract is to slow, and even to arrest, contraction of the auricle. The ventricle continues to beat with an independent, slow rhythm, so that the pulse is very slow. When the vagi are cut, or their cardiac ends are paralyzed by atropine, the strength and frequency of the auricular contractions are markedly increased while those of the ventricle are correspondingly augmented.

The direct action of the extract on the arteries is even more marked than on the heart. A few minutes after the injection, even with the vagi uncut, the blood-pressure rises considerably. When a limb, the kidney, or the spleen is enclosed in a plethysmograph or oncometer, the instrument indicates an enormous diminution in volume of the organ clearly due to contraction of its arterioles. This contraction has been proved to be the result of direct action of the drug upon the muscular tissue of the smaller arteries, and is not due to an indirect action through the vaso-motor centre.

A still more curious circumstance in connection with this new remedy is the smallness of its dose. As little as five and a-half milligrammes of dried supra-renal substance will produce a maximal effect upon the heart and arteries in a ten-kilogramme dog—equivalent to about half a milligramme per dog-pound. From this we arrive at the conclusion that the active principle of the supra-renal capsules, taken in the proportion of not more than a-millionth part of a gramme per kilogramme of body-weight (equivalent to less than $\frac{1}{800}$ grain for an adult man), is capable of producing a well-marked physiological effect. This, in the matter of small doses, comes very near breaking the record. Nitroglycerin will produce its effects in doses of $\frac{1}{200}$ grain and, possibly, upon some susceptible people, in even smaller quantities. The smallest fatal dose of prussic acid recorded is $\frac{6}{10}$ of a grain of the anhydrous acid.

VENESECTION, LEECHING, AND CUPPING

Venesection or bleeding, as a therapeutic agent, was at one time universally practised and is now almost as universally condemned. In times past bleeding, as a remedy, was apt to be employed inopportunely; to be misdirected or pushed beyond its proper and safe limits; but of late medical practice has rushed to the opposite extreme. Men and women often bear large losses of blood with impunity—men from wounds on the battlefield and in accidents; women from uterine flooding; and this not only during health, but also when strength has been reduced by disease. There can be no doubt that the routine employment of venesection in inflammatory diseases was a grave mistake, seeing that it did no good but brought with it evils of its own.

There are many diseases and conditions in which venesection is distinctly harmful. It is contraindicated in enteric and all other specific fevers. It is distinctly injurious in acute rheumatism, and does no good in cases of hyperpyrexia. It is useless in pneumonia, pleurisy, pericarditis, and peritonitis, although, possibly, in cases of pneumonia accompanied by marked cyanosis some relief might follow. It is of very doubtful benefit in cases of hæmorrhage, although in one case of hæmoptysis, where blood had run down the trachea into the bronchi and the patient was livid, it produced a markedly beneficial effect.

Venesection is useful in some cases. In eclampsia from uræmia, including puerperal convulsions and those of advanced Bright's disease, it is distinctly indicated. It is useful in those forms of epilepsy where convulsions are long-continued, or the patient passes into the status epilepticus with impeded respiration and blueness of the surface. In apoplexy it is indicated in the condition of insensibility which is accompanied by cyanosis and stertorous breathing. The pain of aneurism is often relieved by small bleedings; but equal benefit is usually obtained by the use of iodide of potassium, nitrite of amyl, or nitroglycerin.

The most marked indication for bleeding is general venous congestion with cyanosis, dyspnœa, turgid veins, enlarged liver, albuminuria, pulsation in the jugular veins and at the epigastrium, functional incompetence of the tricuspid valve, and a small, weak, and fluttering radial pulse.

Leeching and Cupping are now rarely employed as therapeutic agents. The trade in leeches has dwindled to a miserable fraction of its former magnitude, and the art of cupping and the once thriving and useful race of cuppers are extinct. The consumption of leeches must at one time have been very considerable, for it is stated that the four principal dealers in London imported, on the average, 600,000 a month, or 7,200,000 a year. In France 100,000,000 leeches a year were employed. At the present time the use of leeches seems to be confined almost entirely to ophthalmic surgeons.

Leeches abstract blood from capillaries and smaller blood-vessels, and the effect is that of local bleeding. The quantity of blood which one is capable of drawing varies con-

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siderably, and four drachms is probably the maximum. The average capacity of a leech is about a drachm and a-half. When it has had sufficient it drops off; but if its tail is snipped, it does not perceive the fact and goes on sucking, superfluous blood running out at the other end.

Many accidents are reported from the use of leeches. A young man had leeches applied to his anus and one of them made its way into the rectum. A lady who was applying a leech to her gums, accidentally swallowed it. Some one remembered that leeches could not live in alcohol and advised the administration of brandy-and-water hourly. The lady reluctantly adopted the remedy—but it was three weeks before she was satisfied that the animal was dead.

There are two kinds of cupping—wet-cupping and dry-cupping. Wet-cupping is practically scarification, a number of superficial, parallel cuts being made with a set of sharp lancets. Dry-cupping is the application to the skin of a glass vessel partly exhausted of air by burning alcohol. Dry-cupping is easy to apply, but it is astonishing how few students know how to perform this simple operation neatly. They either fail to make the glass adhere, or burn the patient with the spirit.

Dry cupping, applied freely all over the back, is useful in bronchitis and pleurisy. It is one of the best methods of checking profuse hæmoptysis, and is used with advantage in lumbago and many forms of myalgia.

TRANSFUSION

The idea of transfusion was familiar enough to ancient writers; but they lacked the requisite anatomical and physiological knowledge to put their theories into execution. There is a legend to the effect that transfusion was first performed on Pope Innocent VIII. It is said that his vital powers suddenly gave way and he fell into somnolence so profound that the whole court believed him to be dead.

All means of awakening his exhausted vitality having been resorted to in vain, a charlatan proposed transfusion, by means of a new instrument, of the blood of a young person. The blood of the decrepit old pontiff was passed into the veins of a youth whose blood was transferred into those of the old man. The experiment was tried three days, and cost the lives of three boys, without saving that of the pope. This was in 1492.

In 1651 the idea was revived by a friar named Robert des Gabets, who, seven years later, gave a lecture on the subject at a conference held in Paris; but it does not appear that he ever practised the operation which he so enthusiastically advocated. About this time the subject attracted considerable attention, and Pepys, in his Diary, mentions that on November 14th, 1666, transfusion was performed experimentally, at Gresham College, on dogs.

In 1667 a French mathematician, named Denis, decided to perform transfusion on a human subject. For a long time he failed to find any one willing to submit to the operation; but at last he managed to get hold of a madman, who arrived in Paris naked and without means, and was seized as a fitting subject for the experiment. Eight ounces of calf's blood were transfused into his veins and that night he slept well. The experiment was repeated on the following day and the patient not only slept well, but woke up in his right mind.

Lower and King were emboldened to repeat the experiment in London. They found a healthy man willing to have some blood drawn from him and replaced by that of a sheep. As he felt the warm stream pouring in he declared that it was a delicious sensation and that he would like to have the operation repeated. Tidings of the new discovery flew over Europe; in Germany and Italy transfusion was many times performed with complete success, and it was confidently asserted that the new method of treatment would be universally adopted. These hopes, however, were soon dashed; the patient on whom Denis had operated, again went mad; was again treated by transfusion and died under the operation.

The son of the Swedish Minister, who had been benefited by one transfusion, perished after a second, and in April, 1668, the Parliament of Paris made it criminal to attempt transfusion, excepting with the consent of the Faculty. Thus the whole treatment fell into discredit, to be revived once more in our own day on a scientific basis.

During the last twenty-five years transfusion, as a therapeutic agent, has advanced rapidly in favor, and is now generally recognized as a proceeding of great value. Innumerable treatises and papers have been written on the subject, and various instruments for simplifying (or complicating) the operation have been invented or described by various surgeons. Some recommend immediate transfusion, while others consider that the blood should be defibrinated before being injected. Most writers prefer venous infusion; but others have a leaning towards the arterial method. In all operations on the blood-vessels care would naturally be taken not to introduce air; but Oré assures us that a bubble or two of air is of no importance, and that the quantity to cause death must be considerable—a statement confirmed by the late Mr. Marcus Beck.

Many authors recommend that blood, before being injected, should be diluted with some saline solution, such as phosphate of sodium, while others suggest that, in the absence of blood, an artificial substitute should be prepared. The following solution has been suggested:

Chloride of Sodium,	ʒ j.
Chloride of Potassium,	gr. vj.
Phosphate of Sodium,	gr. iij.
Carbonate of Sodium,	gr. xx.
Distilled Water,	to Oj.

Many writers recommend the addition of a small quantity of alcohol, while others think that the introduction of any salt of potassium—presumably from its depressing action on the heart—is a mistake. In a recent case sixteen ounces of the following solution were injected into a vein, with good results :

Chloride of Sodium,	gr. l.
Chloride of Potassium,	gr. iij.
Sulphate of Sodium,	gr. ijss.
Carbonate of Sodium,	gr. ijss.
Absolute Alcohol,	ʒ ij.
Water (at 100° F.),	℥ xx.

Coates has recorded a striking case in which the injection of twenty-two ounces of simple warm water into the median cephalic vein was attended with favorable results.

Some authors speak favorably of "auto-transfusion." By raising the legs and hips and compressing the abdomen, blood may be made to gravitate toward the heart and brain.

Attention has frequently been called to the value of milk as a substitute for blood in transfusion. Hodder, of Toronto, injected into the veins of three patients, suffering from Asiatic cholera, fourteen ounces of milk, without a bad symptom and with manifest advantage. Joseph W. Howe, of New York, injected six ounces of warm goat's-milk into the cephalic vein of a patient suffering from tuberculosis, and T. Gaillard Thomas, of New York, injected eight and a-half ounces of fresh cow's-milk into the median basilic vein.

Another method of performing transfusion is by injection into the peritoneal cavity. Ponfick injected into the abdomen of three patients 250, 350, and 220 grammes, respectively, of defibrinated blood. The results were favorable, and the slight feverishness and tenderness of the abdomen, at first observed, soon passed off.

COUNTER-IRRITATION

By counter-irritation we understand the application of an irritant to the surface, with the view of diminishing or counteracting any morbid process which may be going on in another part of the system. For example, if a man is suffering from synovitis and we paint his knee with iodine liniment, that is an example of counter-irritation. Many substances are used as counter-irritants; the list including turpentine, ammonia, mustard, cajuput oil, and acetic acid. The most commonly-employed counter-irritant is cantharides.

Blisters differ in their mode of action, according to the manner in which they are employed. The first effect of an application of cantharides is to produce tingling, smarting, and a sensation of heat. After that minute vesicles appear which soon coalesce to form blebs of various sizes. The primary action of a blister is to stimulate; but if the action is allowed to continue, the result is a depression of bodily powers. It must be remembered that serum contains a large proportion of albumin, and that its abstraction is equivalent to bleeding the patient to the same amount.

Flying-blisters are an excellent stimulant, and are of undoubted use in the asthenic condition incidental to many fevers; but it is essential that they should *be* flying-blisters and be kept on only sufficiently long to redden the skin, not long enough to induce the formation of a bleb. Blisters may be applied in quick succession to various parts of the body, such as the chest, abdomen, thighs, and calves of the legs. Flying-blisters do good in pneumonia, pleurisy, asthma, biliary and renal colic, lumbago, and a great number of very different diseases.

When a blister has been allowed to remain on sufficiently long to form a bleb, the latter should not be cut. The skin forms a protective surface and facilitates healing of the subjacent surface. Moreover, if the bleb is protected with cotton-wool, so as to prevent its rupture, the serum is reabsorbed and risk of unduly weakening the patient is avoided.

[ELECTROTHERAPY

Electricity, in various forms, is now a remedial agent of great value, especially in connection with neuropathology.

It is said that Roman physicians placed their patients, affected with gout and paralysis, in baths containing electric fishes or eels, for the benefit which it was thought they might derive from the discharges by these animals. Towards the end of the eighteenth century frictional electricity had been somewhat experimented with; but not until Galvani, in 1786, discovered the existence of the force named after him, and in 1800, when Volta invented an instrument (the Voltaic-pile) which enabled this force to be developed and utilized, did the knowledge of it assume definite shape. Even then little was accomplished for medical art. Indeed, the fact that electricity, mesmerism, and animal magnetism became identified with each other and with arrant quackery, without doubt interfered with the recognition which it might otherwise have received. In 1831 Faraday discovered the phenomena of induction which has since been utilized so largely for therapeutical purposes.

Duchenne (of Boulogne) was probably the first one to give to electrotherapy the prominence to which it was entitled. Remak, du Bois Reymond, Eckhard, Benedikt, and many others quickly followed with their contributions, until the subject has now reached such proportions, and the details connected with the physics, mechanical essentials, therapeutical indications, and methods of electrotherapy are such, that it would be futile to attempt, in a work like this, even an outline description of them.

Such omission should not be understood as indicative of the value of this agent, and the current treatises devoted exclusively to electrotherapy will furnish such information as may be required.]

VARIOUS CURES

There are certain systems of cure concerning which a student should have some knowledge. The number is constantly on the increase, but the following list may serve a useful purpose :

Water-Cure.—This is practically identical with hydropathy and is the treatment of disease by the use of water internally and externally. You have water when you get up, water for breakfast, water for dinner, water for tea, and water when you go to bed. In the intervals you have cold baths, douches, and wet packs. It is useful in rheumatism, insomnia, gout, headache, and menstrual disturbances. In persons not accustomed to it, it induces a craving for whiskey.

Mind-Cure.—The alleged cure of disease through mental operations. It is pretty much the same as "cure by suggestion."

Faith-Cure.—The system or practice of attempting or pretending to cure diseases by religious faith and prayer alone. It is said to differ from "mind-cure" in that the faith-curers have no mind, whilst the mind-curers have no faith.

Grape-Cure.—A cure for pulmonary tuberculosis and other diseases by the ingestion of large quantities of grapes. It is carried out chiefly at Meran, the ancient capital of Tyrol. The patient takes from three to eight pounds a day, the skins and seeds being rejected. They act as a gentle laxative. It is, in reality, a grape-sugar treatment. At one time only a little bread was allowed in addition to the grapes, but of late this rule has been relaxed and now a patient is practically at liberty to eat and drink anything he likes with exception of fat and tough meats, hard-boiled eggs, pickled meats, potatoes and beer. Milk is allowed in unlimited quantities. Patients usually gain weight and find that capacity for exertion increases.

Milk-Cure.—In this form of treatment everything but milk is rigidly excluded, the patient receiving three or four times a day, at strictly prescribed intervals, from half to a whole cupful of skimmed milk, the vessel having been previously warmed by immersion in hot water. It is said to be useful in chronic gastric ulcer, [gastric catarrh, dropsical conditions, and certain forms of kidney disease. Dr. S. Weir Mitchell has found a milk diet very serviceable as an agent in treating badly-nourished, neurasthenic patients. Details of its proper management may be found in his little book called "Fat and Blood"].

Whey-Cure.—This is a modification of the above, but you take whey instead of milk.

Koumiss-Cure.—Koumiss is fermented mares'-milk. The treatment is extensively employed in cases of phthisis, and many striking instances of recovery have been reported. It necessitates a visit to the steppes of European Russia or of Central and Southwestern Asia. Some years ago such an undertaking by an invalid would have been an impossibility; but now, thanks to modern facilities, it is possible to reach the town of Orenburg, on the borders of Southwestern Asia, with but thirty-three hours' railway travelling. The railway journey from St. Petersburg to Moscow occupies only a night, and the travelling is so luxurious that not the slightest inconvenience is experienced. The train leaving Moscow in the evening reaches Nijni Novgorod in the early morning. From there the trip down the Volga to Samara is accomplished in forty-three hours in a large, fast, and comfortable steamer; and from Samara it is only fifteen hours' railway journey to Orenburg. There are several koumiss establishments in the neighborhood, of which particulars can be obtained without difficulty. The climate is magnificent and the life is most interesting. The air is so pure and fresh that the sufferer feels invigorated and, in a very short time, improves in appetite and gains flesh.

Shaking-Cure.—This is a treatment of paralysis agitans by means of a vibrating armchair advocated by Charcot. In default of the orthodox apparatus an omnibus will serve the purpose. It is not adapted for patients with stone in the bladder.

Hunger-Cure.—The scientific name for this is nestiatria (from *νηστεία*=“a fast,” and *ιστεία*=“treatment”). You go to any fashionable hotel furnished with electric light and an elevator, and dine at the *table d'hôte*. It is largely practised at English seaside resorts during the season. It is expensive; but is an infallible cure in the case of the man who is always complaining that he has no appetite.

Schroth's-Cure.—This is a dry-method of treatment [practised by the peasant Schroth, of Lindewiese, a village near Gräfenberg, Austrian Silesia]. The food is freed from moisture and the patient has nothing to drink excepting one small glass of hot wine, night and morning. The dinner consists of boiled vegetables, thick, dry, and seasoned only with butter and salt; the rest of the day nothing but dry bread being taken. The patient suffers much inconvenience, febrile symptoms are induced, appetite is lost, and there is usually intense prostration. Physiologically the effect is to produce concentration of the blood-serum, with accelerated diffusion between the blood and the fluids of the parenchyma. It is not quite clear what good the treatment does, but it is said to be a specific for a cold in the head. It is also useful in obstinate syphilis; in chronic articular rheumatism with effusion in the knee-joint, and in chronic peritoneal effusion.

Kneipp's-Cure.—This is carried out in the little town of Wörishofen, in Southern Bavaria. Its originator, Sebastian Kneipp, son of the village shoemaker, is now pastor of the parish. The system consists in an absolute return to the rudimentary principles and customs of humanity. It is chiefly a cold-water system, carried out with the aid of the river Wettbach. The Kneippists abjure shoes and stockings and walk about in the long, wet grass with bare feet and as little clothing as is compatible with decency.

Schweninger's-Cure.—Respecting this method of treatment it is difficult to speak with any certainty. Prof. Schweninger is physician to Prince Bismarck, and is said to have formulated a strict dietetic regimen which is applicable to the treatment of obesity. It is probable that it is not very different from the system of treatment which is called Bantingism, after the celebrated undertaker. [Some essential features of this method are said to be—abstinence from drinks during meals; avoidance of prolonged muscular exercise; lowering the temperature of limited portions of the body or limbs at intervals by cold bathing; forcible kneading of the abdomen to favor absorption of adipose deposits; avoidance of abdominal support with the aid of belts, etc., and restriction as regards certain articles of food.]

[**"Gold-Cure."**—A method of treating inebriety practised at several special establishments in this country. It is the popular belief that chloride of gold is the chief ingredient of the hypodermic injections which are the prominent feature of the "cure"; but there appears to be little foundation for this or for the alleged existence of apomorphine as the actual remedy. Many successful results are reported; but the authorities are not always very acceptable.]

[**Salisbury's-Cure.**—A method of treating chiefly inebriety, and derangements of the stomach and of nutritive functions, formulated by Dr. James H. Salisbury. It consists, mainly, in sipping slowly a half pint of water, at 110° to 150° F., an hour or more before meals and at bedtime, and, in most cases, restriction, as regards diet, to bread, and finely-chopped, lean beef shaped into flattened cakes and broiled—commonly known as "Salisbury-steaks."]

ACCESSORY TREATMENT

Every practical physician recognizes the value of what is commonly called "accessory treatment"; or, in other words, the importance of resorting to curative methods besides the administration of drugs. In fact, some physicians go so far as to rely almost exclusively on accessory treatment, and give little or no medicine. The term accessory treatment is very wide, but by general consent is recognized as including all matters relating to diet, exercise, clothing, rest, amusement, and so on.

DIET

Dietetic treatment is in many cases quite as important as treatment by drugs, but regulation of the diet alone will not enable us to dispense with the use of medicines. Take angina pectoris, for example. You may afford instant relief during a paroxysm by a fraction of a grain of nitroglycerin or a few whiffs of nitrite of amyl; while regulation of the diet would only prove beneficial by preventing the occurrence of dyspepsia and the formation of flatus. Indirectly it would prove of use in removing certain predisposing causes and lessening the probability of a recurrence of the attack; but for the relief of pain and the accompanying feeling of anxiety, nothing but medicinal treatment would avail.

In cases of gout, and especially of diabetes, dietetics are even more important than treatment by drugs. We tell our gouty patients that they are not to indulge too freely in animal food; that they should abstain from *entrées* as much as possible, and that such things as pork, veal, and all salted and potted or canned meats (which are more or less indigestible) should be avoided. They may take an abundance of vegetables, but should eschew sugar, sweets, and other articles likely to give rise to acidity. Their wines should be carefully selected and port, sherry, and Madeira should be prohibited; although of late years the absurd doctrine has been put forward that gout is due, in many instances, to not drinking enough port wine. The best wine for a gouty man is claret, free from sugar and devoid of acidity; but far better than any wine is good whiskey taken only at meals, in strictly limited quantities, freely diluted with some effervescing water, such as the lithia.

In cases of diabetes mellitus, sugar introduced with food or formed within the organism is only imperfectly applied in the animal economy, the greater part being washed out of the body with the urine without undergoing any change. In the case of diabetics we prescribe a dietary free from sugar and sugar-forming substances. Practically it comes to this—that the patient must not take sugar nor starch. He may have as much meat as he likes, in any form excepting liver; but he must avoid not only sugar, but wheaten bread, rice, arrowroot, sago, tapioca, potatoes, carrots, parsnips, beets, pastry and puddings of all kinds, and fruit. He may drink dry sherry, claret, and hock, but must abjure champagne, port, and liqueurs. The great difficulty is in doing without bread; but he may have gluten bread, almond bread, or soya bread.

Many tables or dietaries for the use of diabetics have been published, the best-known being those of Pavy, Seegen, Roberts, Germain-Sée, Dujardin-Beaumetz, Bouchardat, Cantani, Ebstein, and Düring. They are all pretty much on the same lines, differing only in matters of detail.

In the case of consumptives, or of those predisposed to consumption, we give the patient as much meat as he can assimilate, with plenty of fat in a readily digestible form. He has rum and milk the first thing in the morning; bacon, and coffee with plenty of milk in it, for breakfast; white beans or lentils soaked in butter at dinner, and cream in all shapes and forms. Whenever there is an opportunity for getting it in, cod-liver oil is a convenient form of administering fat; and if the patient likes milk, we give him five or six pints a day, diluting it with soda-water, or lime-water, or anything that will make it digest more easily. The patient must have plenty of lime with his food, and it is a good plan to make a cordial composed of fresh eggs, the shells of which are dissolved in lemon-juice and then beaten up with rum.

People who, although free from any organic disease, are distinctly below the average weight for age and height, and are incapable of much exertion, have to be catered for on the same lines. They must have plenty of meat, plenty of fat, and plenty of lime Milk, cream, koumiss, cod-liver oil, extract of malt, sugar, and fruits are beneficial in such cases. Many dietaries for these patients have been published, but if there is not one at hand ready-made, it is not a very difficult matter to improvise something which will meet the requirements of the particular individual.

For every person who wishes to get fat there are a hundred who wish to reduce their weight. A woman who puts on flesh and loses her figure is the despair of her dressmaker and gives herself up as lost. There are dietaries for the use of the corpulent, the majority aiming at knocking off sweets and starch. Some people adopt the Dancel system, and go in for a dry dietary ; others pin their faith to Banting; others swear by Ebstein or Oertel, while many believe in Schweninger's method. Some follow no system, but resort year after year to some particular place, such as Carlsbad, for a course of treatment. Many undoubtedly derive benefit from the limitation of food, but others injure themselves, perhaps permanently, by too rapidly reducing their weight.

Every medical man should understand something about cooking. He need not be an expert cook, but he should know, for example, all about sauces. He should be able to discuss, with a certain amount of intelligence, the modes of preparing *sauce blanche*, *sauce Hollandaise*, *sauce diplomate*, *sauce soubise*, *sauce béarnaise*, and other equally well known sauces. The doctor, too, should know how to make coffee by means of an earthen percolator, and should have definite ideas on such subjects as hominy and porridge. He should be able to order a good breakfast, luncheon, or dinner, and should be well up in such subjects as kedgeree, chicken coquilles, macaroni, salads of all sorts, soufflés, and savories.

The breakfast for a convalescent should include tea, coffee or chocolate, porridge or hominy, poached eggs, ham or bacon well grilled, kippers, bloaters, Findon-haddocks, cold meats, and marmalade or fresh fruit.

For luncheon he may have the choice of beef-tea or chicken-broth (both either hot or in the form of jelly), breast of fowl, sweets, savory, cheese (Brie, Camembert, Roquefort, or Gorgonzola by preference), fresh fruit, and a cup of black-coffee.

At dinner he will have to fall back on Russian caviar (in jars, not in tins), oysters (when in season), clear soup, fish, sweetbreads, chicken-breasts stewed in their own juice, cutlets, game, vegetables and sweet omelette (with or without rum), a little cheese, fresh fruit, and coffee.

There can be no doubt that good cooking and the careful selection of dishesis conducive to the maintenance of health. Brillat-Savarin, the suave and sympathetic gour met, says:

"It has been proved by a series of rigorously exact observations that by a succulent, delicate, and choice regimen the external appearances of age are kept away for a long time. It gives more brilliancy to the eye, more freshness to the skin, more support to the muscles; and as it is certain in physiology that wrinkles—those formidable enemies of beauty—are caused by the depression of muscle, it is equally true that, other things being equal, those who understand eating are comparatively four years younger than those ignorant of that science."

The effect of habitually eating coarse and badly-cooked food is at once apparent, not only on the skin, but on all the functions of the body. Good-feeding is conducive, not only to bodily development, but to increased brain-work. Although there have been many exceptions (some very notable ones) it is, as a rule, from the well-fed classes that our eminent men arise.

CLOTHING

For the efficient maintenance of health strict attention must be paid to dress. The chief materials employed in making clothes are cotton, linen, jute, wool, silk, leather, and india-rubber. These, of course, simply form the substratum, for the materials employed for purely decorative purposes are endless in number and vary from season to season. Cotton garments wear well; do not shrink in washing; do not readily absorb moisture; and conduct heat less readily than linen, but with much greater facility than wool. Cotton is cheap and durable. It is the sole constituent of calico, but merino is cotton with the admixture of from twenty to fifty per cent. of wool. Linen is smoother than cotton, and absorbs moisture and conducts heat somewhat more readily. It is often starched to give it a glossy appearance. Jute is largely employed to mix with other fabrics. Wool absorbs water readily and is a bad conductor of heat, so that it always feels warm. It is not easily penetrated by draughts and is the typical form of dress for rheumatic and neuralgic patients. It is the best material for blankets, preventing the radiation of heat during the night and in early hours of the morning. The great objection to its universal employment is that, if sent to the ordinary laundress, it shrinks and after a few washings is rendered utterly unfitted for use.

Leather is chiefly used for boots, but is sometimes employed for leggings, coats, and trousers. It is very warm, and, as wind cannot penetrate it, is especially adapted for cold climates. The thinner varieties are perfectly supple.

India-rubber clothing has the reputation of being "heating." It prevents evaporation of perspiration and in a short time becomes unbearable. It is best adapted for overcoats, and for occasional wear during a shower. When spread on damp ground it serves as a protection for those who are obliged to camp out. It cracks in cold climates, and is apt to become soft and sticky when exposed to excessive heat [and when it has been in contact with oil or grease].

With regard to the minor modifications of clothing it is difficult to offer any opinion, and the subject cannot be dealt with on scientific principles.

EXERCISE

Exercise is of almost as much importance as regulation of diet and administration of medicines in the treatment of many diseases.

The subject is clearly capable of being dealt with from many different points of view. Exercise is a potent factor in the maintenance of health, and it has often been said that a condition of perfect health without exercise is an impossibility. Exercise, in addition to being a prophylactic, is a curative agent, and many diseases are appropriately treated by active or passive movement. On the other hand, excessive exercise—that is, abuse of exercise—may produce the condition known as overstrain and be the forerunner of disease.

Physiologically, exercise increases the oxidation of carbon, and, perhaps also, of hydrogen. It helps to eliminate water from the system by increasing perspiration. The pulmonary circulation is hurried, and the quantity of air inspired and of carbonic acid eliminated is increased. The action of the heart is increased in force and frequency, and the flow of blood through all parts of the body, the heart itself included, is augmented. Severe exercise increases the elimination of urea ; but the increase, both on an ordinary diet and on a dietary free from nitrogenous food, is small. The quantity of urea passed during any period is largely dependent on the nitrogenous condition of the body at the time—that is, it varies according as a greater or smaller reserve of nitrogenous material has accumulated.

The influence of exercise on the nervous system is a matter which has excited much controversy, and by many it is maintained that it dulls the intellect and is inimical to good work ; but, on the other hand, it is urged that without exercise the mind soon becomes morbid and is

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the greater amount of physical exercise he requires. This may be all right on theoretical grounds, but it is found, practically, that a man who works hard with his brain and at a high pressure cannot take severe physical exercise. It is customary to tell middle-aged men who are actively engaged in business all day, that they would benefit by riding before breakfast. A man of robust constitution will perhaps manage it, but many patients who have made the attempt say that the effort is too great for them, and that the exercise tires them so much that they are unable to pay the same close attention to business as usual.

Walking is often considered a good exercise, but in reality it is not, for, although the muscles of the legs are called into play, the arms are left uncared for. Moreover, walking in a town is almost an impossibility. A man cannot walk in a frock coat and tall hat, and his walking soon degenerates into a stroll. Even in the country walking is not a very amusing form of exercise unless the walk is undertaken with an object or in pleasant company. Even a long walk is not satisfactory, for the distance covered is so short, compared with what can be done on a bicycle, that there is naturally a feeling of disappointment.

If exercise is to do any good it must take the form of amusement. The great merit of cricket [and similar sports] is that it leaves no part of the body unexercised; arms and legs are equally used, and in batting and fielding alike every muscle is constantly brought into play. A good cricketer must exhibit quickness of vision and thought, sound judgment, boldness, brute strength, and great delicacy of muscular adjustment. Swimming is good because it involves an equal use of the arms and legs, and, being practised in a state of nudity, there is no impairment to respiration. Lawn-tennis is good for strong, healthy young people of either sex; but for people of more mature years golf has many advantages. Of indoor amusements billiards is by far the best. The great disadvantage is that it has often to be played in public rooms which are unreasonably hot from being lighted with gas. Still it is an excellent exercise and brings both arms and legs into play. When there is not room in the house for a full-sized table, the end of a table six feet by four will afford ample opportunity for practising spot-strokes and carroms, and of taking exercise in a pleasant form.

Massage is a scientific method of treating certain forms of disease by systematic manipulation. The following are the chief movements:

Effleurage.—A stroking movement made with the palm of a hand, which is passed, with various degrees of force, over the surface of the body.

Pétrissage consists, essentially, in picking up a portion of the soft tissues with both hands, or the fingers of one hand, and subjecting it to firm pressure, rolling it, at the same time, between the fingers, or the fingers and the adjacent parts.

Friction, or *Massage à frictions*, is performed with the tips of the fingers, which keep up a rotary movement.

Tapotement is a kind of percussion made with the tips of the fingers, the palm of the hand, the back of the half-closed hand, or the ulnar or radial border of the hand.

These movements are combined in various ways, and the treatment has been found useful in gout, rheumatism, obesity, constipation, insomnia, and some forms of paralysis. [Also, as a valuable means for promoting general nutrition, especially when customary exercise is impracticable; for reduction of dropsical swellings, relief of myalgia, etc.]

LIGHT

There is good evidence to show that light, and especially direct sunlight, exercises a beneficial influence in maintaining the general standard of health. Italians have a proverb to the effect that "Where the sun does not enter, the doctor does"; and amongst the Indians there is a saying that "He who plants a tree in the front of his dwelling begins to dig his own grave." In connection with this subject reference may be made to a paper "On the Influence of Light upon Protoplasm," by Dr. Arthur Downes and Mr. Thomas P. Blunt, published in the Proceedings of the Royal Society. In this valuable and suggestive paper it is shown, by a series of elaborate experiments, that light is inimical to and may, under favorable circumstances, wholly prevent the development of bacteria and organisms associated with putrefaction and decay. An attempt was made to ascertain with what part of the spectrum this property of light was associated, and the conclusion arrived at was that it depended chiefly on the blue and violet rays.

Practical men have long recognized the value of direct sunlight in the treatment of disease. Dr. Pollock states that a freckled child is rarely consumptive. He says that there is not only mental invigoration in sunlight, but there are vital agents assisted and possibly developed by it. Dr. Hermann Weber bears equally emphatic testimony as to the value of sunlight, and suggests that, when possible, patients suffering from consumption should be placed on a terrace or balcony sheltered from cold winds, but exposed for many hours during the day to the full direct rays of the sun.

It is important, in the selection of a place of residence for a person suffering from lung trouble, that the aspect should be due south. The best arrangement is to have the sitting-room on the ground-floor, and the bedroom immediately over it. When, from necessity, both rooms are on the same floor, the sitting-room should face the south, and the rooms should communicate by folding-doors, which should be left open during the day, to permit of the sun shining through them into the back room.

Reflected sunlight is not without a beneficial influence, and when rooms on the same floor face east and west it is quite easy to arrange half a dozen small mirrors so that, during many hours of the day, both rooms get the benefit of sunlight. If the mirrors are objected to on the ground that they are not sufficiently ornamental, they can be painted with flowers, should that special form of art excite the fancy of the occupants of the rooms. The typical housewife is very fond of pulling down window-blinds when the sun shines, to save the carpet from fading; but this is paltry economy which should not be tolerated for one moment.

Attention may be called, in this connection, to an interesting paper by Siemens, "On the Influence of Electric Light on Vegetation." He showed that plants progressed much more readily, and attained a much higher degree of development, when subjected to the influence of sunlight by day and of electric light by night, than when exposed to the action of sunlight only. It is true that he experimented with an electric light of 1,400 candle-power, driven by a three-horse-power, Otto gas-engine; but for indoor work a light of much less intensity would suffice. It is conceivable that anæmic and consumptive patients would make better progress in a house well lighted with electricity, especially in London during winter months, when the sun is rarely seen and the hours of daylight are short. Electricity, as a lighting agent, can now be obtained at so small a cost that the experiment is worth trying.

APPLICATION OF HEAT AND COLD

Heat and cold, in their actions on living organisms, have long been the subject of study and experimentation, and many interesting and curious facts have been determined by these researches.

Heat.—Distinction must be made between wet-heat and dry-heat. While it is found to be impossible for a man to keep his hand in water at a temperature of 124° F., he can remain five minutes in air at a temperature of 200° F. without much inconvenience. If the air is perfectly dry a temperature of from 280° to 300° F. can be sustained.

Various observations on the effect of heat have been made on the lower animals. Lautenbach has shown that heat, when applied to the motor nerves of frogs, produces movements in the muscles both by its action as a simple irritant, and by its destructive effects. Heat acts as a simple irritant at temperatures ranging from 68° to 135° F. The influence which these moderate degrees of heat exert on motor nerves resembles that induced by the galvanic current, in that muscular contractions commonly occur either on bringing the heated object in contact with the nerve or on removing it. When the foot of a frog is placed in warm water, reflex movements are produced. These reflex movements occur at a lower temperature in the case of posterior extremities than of the anterior. The lowest degree of heat, applied in the form of hot water, which produced reflex movements in the posterior extremities of a frog was 84° F.

DRY-HEAT produces little or no effect on certain kinds of frogs. The *Ranæ esculentæ* allow themselves to be burnt freely with a hot iron, without resenting it in any way. This is not true of all frogs, for the *Ranæ temporariæ*, and various kinds of toads, move off directly if touched with heated metals. In the case of the esculent frogs, it is not only the skin which is impervious to the action of dry-heat, but the nerve-trunks themselves are absolutely insensible to this method of irritation. It is only to dry-heat that the *R. esculentæ* are insusceptible; for they display the greatest possible objection to the application of moist-heat. When the hind legs of one of these frogs is dipped into oil at a temperature of 205° F., vigorous reflex movements are induced; but when the leg is brought in contact with the metal vessel containing the oil (which is, of course, at the same temperature) no effect results. In the same way, when a piece of metal is dipped in the hot oil and wiped dry, it in no way incommodes the frog.

Some mammals experience no pain from the application of a very hot iron. For example, a deep burn made in the ear of a large brown rat seemed only to tickle the animal. It brushed its ear with the anterior extremity of the same side (a movement identical with that which it had previously made when the ear was tickled with a feather), but it made no effort to escape. When, however, the iron was allowed to cool, the slightest touch obviously gave pain. Burning its tail with a very hot iron caused the animal to lazily turn its head and smell the burning part. Touching the skin with hot water immediately gave rise to frantic efforts to escape. The same apparent indifference to the application of a hot iron has been observed in the case of pigs.

Some people seem rather to like the application of an actual cautery. A patient of mine who was paralyzed had it applied to his spine several times, and refused an anæsthetic, maintaining that the sensation was rather pleasant than otherwise.

The heart of a frog, exposed to a high temperature, soon becomes unduly active and fails to contract properly. The explosion of the contractive substance is prematurely induced before a sufficient supply of explosive material is accumulated, so that each stroke becomes more and more feeble, and, as the rate is quickened, the beats become irregular and finally cease.

The influence of heat and cold modifies the action of veratrine on muscle, and, reasoning from analogy, it is probable that temperature modifies the action of other drugs, not only on muscles, but on nerves and nerve centres.

The effects of heat on the human body vary with the degree of heat, the slowness or rapidity of transition from a low to a high temperature, and, also, with the length of exposure. Other modifying conditions are met with in the constitutional state of the individual, in the amount of moisture in the atmosphere, and in the condition of health. The range of temperature within the limits at which life can be maintained is greater in the case of man than of any other animal.

Dry-heat can be borne with much less inconvenience than moist-heat. In one case a temperature of 210° F. was sustained for twenty minutes; in another a temperature of 260° F. was sustained for eight minutes. Workmen have been known to enter a drying-oven in which the thermometer stood at 350° F. Stokers often carry on their work at temperatures of from 120° to 160° F. In these cases the profuse perspiration which is induced exerts a cooling influence and prevents any material rise in the temperature of the body.

Heat employed in the form of a cautery acts as a counter-irritant. The custom of "firing" stiff joints is a very old one. The Paquelin cautery is used with advantage over the region of the spine in many cases of chronic paralysis. The application is not so painful as might be supposed [if the instrument is at a white heat].

[WARM AND HOT AIR-BATHS have several uses in medical practice. In Russia it has long been customary to enclose immature and feeble infants in a receptacle in which an elevated temperature could be maintained. Credé and, more recently, Tarnier, of Paris, have brought this method into general notice, and a *couveuse*, or warming crib, after the model suggested by the latter, has become quite well-known. In it an infant is enclosed by double walls and a glazed cover, and the temperature is maintained by water in the space between the walls or in the double bottom, heated by a lamp. Combustion is regulated by a mechanical contrivance and thermometer. Dr. John Bartlett described[1] the details of construction of such a crib and how to use it. In Bartlett's crib an inside temperature of 86° to 92° F. was maintained by water at 122° F., the air of the room being 70°.

In dropsical cases, especially with those of acute nephritis, and when it is expedient to avoid disturbance and effort such as might attend the use of a hot tub-bath, it is sometimes customary to resort to a bath of hot air, thus:

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[1] The Chicago Medical Journal and Examiner, May, 1887.

By means of a frame-work of wire or wood the bed-clothing is supported so as to leave a free space about the body and limbs of a patient, and into this space a current of hot air is directed through a conical iron pipe. This pipe passes horizontally through a metallic box (which at other times serves as a container for the apparatus), which keeps the bed-clothing from contact with the hot pipe. Outside of the box the pipe bends downward at a right-angle and in its lower end is placed an alcohol lamp. To secure a current of air, a small opening should be left at some convenient place under the bed-coverings. It is also well to put a folded blanket under the patient to absorb the sweat and avoid soiling the mattress. When perspiration does not readily occur, it has been found that anointing the surface of the body with oil, or some variety of petrolate, will quickly start its flow, and it is usually so abundant as to saturate whatever is beneath the patient. To arrest the flow, dry the skin quickly with a warm towel.]

MOIST-HEAT is much more prejudicial and few people are able to remain in a vapor-bath, at a temperature of 120° F., for more than a few minutes.

The effects experienced by those exposed to a great heat vary with the temperature, the duration of exposure, moisture of the air, and the amount of effete material in the atmosphere. The first sensation is usually agreeable ; but this is succeeded by one of heat and oppression, which is relieved as perspiration becomes profuse. The initial stimulation of the nervous and muscular systems is rapidly followed by a feeling of languor and depression, so that mental effort is an exertion, and there is a tendency to dizziness and faintness. If the temperature continues to rise, or is long maintained, the symptoms induced resemble those of sunstroke. A person exposed to a high degree of heat is safe so long as his temperature does not rise more than ten degrees above the normal.

The usual cause of death in people exposed to a high degree of temperature is heart-failure. The cardiac myosin coagulates at a temperature of 115° F., and even at a much lower temperature its condition is seriously affected. The regulative heat-mechanism is unable to withstand the strain of too great an external heat, or of too prolonged an exposure to a great, but less degree of heat. It is possible that the chain of events leading to death may not take exactly the same course in every case; but there can be no doubt that a high temperature increases metabolism of the various tissues. Mammalian muscles become rigid at 120° F., but death always occurs before that temperature is reached by the blood.

General Baths.—It may be convenient to indicate the temperatures of various baths :

Cold,	below 70° F.
Tepid,	from 85° to 95° F.
Warm,	" 96° " 104° F.
Hot,	" 102° " 110° F.

The effect of an indifferent-, or tepid-bath is not very marked, and is almost confined to the peripheral extremities of the nerves. There is no excitation of the nerve-centres or of the circulatory system. Neither the pulse nor the secretions are affected, and the temperature of the body remains unaltered.

A general warm-bath produces sensations which are commonly agreeable. The pulse and respiration become more frequent, and there is dilatation of the blood-vessels of the skin followed by perspiration.

Hot baths are more easily borne if the temperature of the water is gradually raised. If a bath is very hot the pulse is greatly increased in frequency and the respiration becomes anxious and quickened. There is a sensation of throbbing in the head and the blood-vessels pulsate violently.

Hot-baths are employed, therapeutically, in the early stages of a cold ; in bronchitis ; in the treatment of renal and biliary colic ; in Bright's disease ; in chronic rheumatism, and in painful menstrual disorders.

The duration of a bath will depend on the age and strength of the patient; on the nature of the affection from which he suffers; and on the temperature of the water. A very hot bath can be borne for only a few minutes; but in some chronic skin diseases patients are kept in a tepid-bath for many consecutive hours.

VAPOR BATHS.—In addition to the bath of water, heat may be applied to the body in the form of vapor. This is commonly known as a vapor-bath and it assumes two forms—one, in which the vapor is inhaled, as in an ordinary Russian-bath; the other, in which steam is applied to the body enclosed in a box, the head protruding through an aperture in the lid. A vapor-bath is usually given at a higher temperature than a water-bath; but 122° F. is the limit which is readily borne. The vapor-bath produces profuse perspiration and is useful in a great number of painful chronic affections. [Vapor-baths containing lime are also customary in cases of membranous croup.] In the Turkish-bath [—where dry-heat is used instead of hot vapor, as in the Russian-bath—] the patient has a cold douche before going into the open air, to contract the blood-vessels of the skin.

PARTIAL BATHS.—The local application of heat in the form of a douche, foot-bath, or sitz-bath has much the same effect as a general warm-bath, but on a smaller scale. The blood-vessels are dilated, and the vascular distension extends to the adjacent parts.

[Vaginal douches of water at about 115° F., or higher, are very commonly used for relief of pain and congestion in pelvic viscera. To obtain this effect the douche must be as hot as can be borne without discomfort when a glass or hard-rubber nozzle is employed, and it must be continued for at least twenty minutes to secure firm contraction of blood-vessels. To favor this condition salt is often added to the water until it has a specific gravity slightly greater than blood-serum, and thus promotes osmosis outward; and, when practicable, the patient takes the douche while lying on the back with the pelvis raised. Akin to this is the use of hot water for arresting capillary bleeding. In both cases it is found that vascular contraction, following the use of hot water, is much more persistent than when cold water is employed.]

A hot foot-bath, with or without the addition of mustard, is useful at the onset of a cold, and a sitz-bath is frequently resorted to by women whose menstrual flow is retarded or suspended. In the case of the sitz-bath, the effect is produced by dilatation of the blood-vessels of the pelvic viscera.

There are many different kinds of composite liquid baths, such as the sea-water bath, alkaline-bath, nitro-muriatic-bath, bran-bath, seaweed-bath, pine-leaf-bath, the mustard-bath, and so on.

Poultices and fomentations are, practically, local hot-baths applied to a portion of the skin. A poultice is composed of materials, such as ground linseed, which swell up on the application of boiling water. They are applied hot to inflamed portions of the skin, to promote absorption or disintegration of the products of inflammation. The warmth and moisture relax the tissues and abate the tension due to inflammation. When matter has formed, poultices or fomentations facilitate its passage to the surface and subsequent expulsion, and limit the spread of inflammation in other directions. They also prevent evaporation from the skin; the water, being held by the pultaceous mass, does not penetrate the skin and prevents it from becoming sodden. Dry-heat would cause irritation, and the simple application of hot water would injure the skin by imbibition.

Cold.—The general effect of cold upon the system is to lower vital activity and metabolism of the tissues. Cold, however, varies in its effects according to the degree, duration of exposure, and the extent and manner of its application. Moderate cold, applied for a brief interval, acts as a tonic and is followed by a stage of reaction. Dry cold is much less injurious in its effects than moist cold or cold accompanied by wet. Immersion in water cools much more rapidly than exposure to air at the same temperature, and a constant renewal of the cooling medium materially hastens reduction of the temperature of the body. It is a common experience that sitting in a draught of only moderately cool air, is much more likely to produce a chill than a lower temperature when the air is still.

One of the first effects of exposure to extreme cold is, after a brief period of congestion, contraction of blood-vessels, the capillaries contracting to such an extent as to prevent the passage of blood-corpuscles. The diminished metabolism which quickly ensues, influences, first and chiefly, the central nervous system, especially the brain and those centres which are concerned in the maintenance of consciousness. This condition is intensified by the slowing of the heart and interference with respiration. The result is the production of drowsiness which is akin to sleep, but differs from it in its tendency to pass insensibly into death.

Some warm-blooded animals—scattered members of several groups of mammalia—assume every year a condition of hibernation or winter-sleep. The heart beats slowly, the respirations are few and far between, and there is a diminished activity of the tissues, the various functions of the body being practically held in abeyance. This condition is due partly to cold, but not entirely, for, in the case of the dormouse, the animal will fall into its winter-sleep at a temperature considerably higher than that at which it awakes in the summer. The influence of cold on the frog's heart closely resembles that of atropine. Both diminish the number of beats, prolong and strengthen the systole, prolong the diastole, and increase the diastolic dilatation of the ventricle. The diastole is prolonged much more than the systole.

Cold may be applied in the form of a cold-bath; as a douche; by wet-packing; by cold compresses; in the form of an ice-bag, or by irrigations, lotions, or injections.

MOIST COLD.—Cold-baths have a marked influence in lowering not only the surface heat, but the temperature of the body generally. Immersion of a patient in a bath at 60° F. for ten minutes reduced the axillary temperature from normal to 94.6° F., and temperature in the rectum by a degree and a-half. The temperature, even after prolonged immersion, is rapidly restored, the normal being usually regained in a little over half an hour.

The first effect of a cold-bath is to produce shivering; blueness of the lips, nose, and extremities; a fall in the temperature of the skin; a quickened pulse, and convulsive, sobbing breathing. A condition of reaction soon ensues, the skin becomes ruddy and glowing, the breathing full and easy, and the pulse quick and strong. If the bath is prolonged, a condition of depression again ensues, the patient gets blue and shivers, and experiences a feeling of depression and wretchedness. The art of taking a cold-bath is to stay in it just sufficiently long to ensure a good reaction. The explanation of a feeling of mental exhilaration, which is experienced by healthy people after taking a cold-bath, is that there is contraction of the vessels of the skin and an increased blood-supply to internal organs.

The effect of a cold-douche is very much the same as that of a cold-bath, but, as it exerts a much more depressing influence on the system, it must be of short duration.

In wet-packing the patient lies extended on two blankets, over which is placed a sheet wrung out as dry as possible with cold water. The patient is then enveloped in the sheet and tucked in tightly with the blankets and is left to perspire for as much as he is worth. This wet-pack is largely employed in a number of diseases, including specific fevers, rheumatism, and inflammatory affections.

DRY COLD.—An ice-bag to the spine has been extensively lauded as a remedy for sea-sickness, and for many functional nervous diseases.

[Probably one of the most efficient and convenient means of obtaining a localized low temperature, without muss or moisture, is the cold-coil made of small india-rubber tubing. The coil is laid upon the surface to be treated ; one end of the tubing is put into an elevated bucket containing ice and water, and the other into a receptacle lower than the coil. The flow is started by suction or by filling the tube with a syringe, and the tube then acts as a siphon. The flow may be regulated by tying a knot in the outlet-end and tightening or loosening it, according to circumstances. With care to exclude fragments of lint, straw, etc., which would choke the tube ; by arranging the coils to prevent their obstruction by pressure, and by keeping a supply of water in the reservoir, the flow is constant.]

The cooling lotion, so generally employed in surgical affections, consists of two and a-half ounces of alcohol and half a pint of water, with or without the addition of four drachms of nitrate of potassium or chloride of ammonium.

The use of ether sprayed on the part, as a means of inducing local anæsthesia, is so well-known as to call for but little comment. The ether must be the pure, anæsthetic ether, and its effects are available only for minor operations. A certain amount of pain is experienced as the part thaws, and, in people of feeble circulation, chilblains sometimes result.

[Ethyl-chloride has, of late, come into use as an additional means for quickly producing local insensibility. It is extremely volatile, and has to be kept in strong glass containers which, for convenience in using, are closed firmly by means of a metallic screw-cap. On the removal of the cap a fine stream of the liquid issues with sufficient force from the pin-hole orifice to be projected several feet, and, being directed upon the part to be affected, it evaporates rapidly and the skin is frozen within a few seconds.]

CLIMATE

Change of air and the selection of a suitable health-resort are important accessory modes of treatment.

Every autumn thousands of invalids rush off to the Riviera, and do not return to our shores until the summer is well advanced. They put up with high charges and a good deal of inconvenience for the sake of sunshine and the beautiful climate. It is quite an open question if some of them would not do equally well if they wintered nearer home.

The choice of a health-resort for consumptives is a matter of vital importance. Formerly they were packed off to Madeira, but now the high Alpine stations find more favor, and the cry is for a high, dry climate, and not for a mild, relaxing situation. Chronic bronchitics do badly in England during the winter, but their life is by no means an unpleasant one if they can afford to winter abroad. People who are neuralgic or rheumatic soon discover that they cannot live on clay-soil, and that their house should be built either on sand or gravel. The best situation for their residence is on the slope of a hill facing either due south or southwest. Rooms with a northern aspect are quite undesirable in northern latitudes.

A sea-voyage is one of the cheapest and most comfortable means of obtaining fresh air at the disposal of the convalescent, and many lines lay themselves out to accommodate tourists and invalids.

A person with an inherited taint of phthisis need not have a bad time of it, provided only that he has means. A well-known writer on consumption says: "Let those who have money, and to whom there exists no necessity for increasing their means, visit the interesting and beautiful parts of their own country. Let them go abroad and see what is new in institutions, wonderful in natural phenomena, grand in nature and worthy of study in art. A long and healthy sea-voyage may convey them, in renewed vigor, to the calm and even climates of Tasmania or New

Zealand, or the more bracing air of South Australia. Here let them live on horseback and enjoy all that is new and exciting in these younger nations of the earth. The extremes of climate are not forbidden them, and a winter in Canada or a summer in Norway may lend them new vigor. In the pure and invigorating air of the upper regions of Mexico, Oregon, or Peru; in the exciting atmosphere of the Cape, are to be found, it is said, fresh pleasures to the senses and stimulants to the nervous and muscular powers, such as must be experienced to be described. But man can bear and even profit by all extremes. The relaxing influence of Grecian or Roman plains or of Egypt; the fresh, dry, and calm desert-air; the life lived in tents, are spoken of by travellers as giving new vigor from the healthy tone which is imparted to nervous and muscular powers. We have all met with men who have done much of this—cultivated men, and not mere idlers—wanderers of necessity and of liking, who have fought off the inherited taint, and who have lived to old age, hardy, vigorous, and 'temperate in all things.' And this (which need not be an altogether selfish existence, but may include many to help and much that is useful to do) is one of the high and pure enjoyments which, in certain cases, money is permitted to purchase."

[The greater or less degree of heat to which a country is subject constitutes the controlling agency in influencing climate, this being chiefly determined by its latitude. As a general rule, the greatest degree of heat prevails in countries lying beneath, or close to, the equinoctial line, the temperature decreasing in direct ratio to the distance from that line. There are, however, numerous subordinate phenomena tending to modify the climate of different districts, first of which may be mentioned the agency of large areas of land in the form of continents, which influence climate by distributing heat and thus elevating the temperature. An illustration of this effect of contiguous countries upon temperature may be had by a comparison of that portion of Europe occupying the temperate latitude, with the corresponding zone in North America. If we trace upon the map the course of the forty-fifth parallel of latitude, we shall find that it traverses the semi-tropical regions of Northern Italy and Southern France, but, crossing the Atlantic, it passes through the centre of Maine, where, for a period of four or five months of each year, the ground is covered with several feet of snow, and through Lower Minnesota, where snow seldom thaws during the winter months, reaching the Pacific at Oregon. Here a milder climate prevails, with a snowfall of but a few inches; vegetation being about a month in advance of that part of New York occupying the same latitude.

The chief cause of the milder climate of the Eastern hemisphere is the heat proceeding from the warmer land-areas lying south of, and within, the torrid zone. It is well known that large masses of heat transmitted by the sun are accumulated and radiated by the earth in the torrid zone; and since, in the Eastern hemisphere, the land-area within the tropics is much greater than in the Western, the amount of heat received and radiated by Africa, Arabia, and India, situated in the low latitudes, greatly exceeds the quantity accumulated by the corresponding portions of South America, the comparative area of which is much smaller. In like manner, the temperature of the Northern hemisphere is, as a rule, warmer than that of the Southern, on account of its more extended land-area. It should be remarked, however, that the climate of certain portions of the coast in both hemispheres is modified not only by the atmospheric currents, but also by the influence of large ocean-currents of heated waters proceeding from the torrid zone. Thus, the climate of England is rendered softer than that of the corresponding land upon the continent of Europe, from the effects of the warm waters of the Gulf Stream; while a similarly warm current in the Pacific Ocean, called the Kuro Siwo, the existence of which was first shown by Commodore Perry, exercises a like influence in moderating the climate of Japan and the islands in the vicinity.

A further comparison of the climates of Europe and the United States will show that both the humidity and the temperature of the atmosphere are influenced by the configuration of the land. It has been found by long-continued observations that three-fourths of the number and force of the winds recorded in the belt lying between 35° and 50° north latitude come from a westerly direction. In America these westerly aërial currents, laden with moisture evaporated from the North Pacific Ocean, are rendered arid and cool, especially in the colder seasons, by being deflected upward in their passage over the elevated mountain ranges of the Sierra and Rocky Mountains, which, extending in the form of a lofty and almost unbroken barrier along the western coast of the United States, condense suddenly the moisture conveyed in the atmosphere. The consequence is, that while upon the western slope of these mountains the rainfall exceeds that of any other part of the United States, amounting to sixty-five cubic-inches for the year, at points less than two degrees of longitude east of these mountain ranges the average rainfall reaches to but seven and one-half cubic-inches. The soft, humid breezes from the ocean having, in this manner, parted with their heat and moisture at the elevations to which they are carried, the climate of the interior is rendered drier and cooler. On the other hand, the west of Europe, within a corresponding latitude, presents no such lofty wall of table-lands and mountains; hence the warm, humid sea-atmosphere proceeding from the Gulf Stream is carried, unobstructed and but gradually modified, over the entire continent.

From the above statements it will be seen that *isothermal* lines, or lines which, as was first indicated by Humboldt, connect places on the earth having the same average temperature, are not necessarily determined by the distance of these places from the equator. Furthermore, while the climate of any given locality is established chiefly by its latitude, it is largely modified by its height and its immediate surroundings—such as large bodies of water, mountains, or forests.

Equability.—A distinguishing feature of American climate, taken as a whole, as compared with that of Europe, is found in the irregular disturbances and changes that occur in the temperature, humidity, quantity of rain, winds, and cloudiness. The climate of Europe is comparatively equable, whereas that of North America is quite the reverse; one result of which is that the prevalent type of vegetation is, in each country, peculiar to itself. At New York, Charleston, St. Louis, and Fort Snelling, the monthly range of temperature is much higher than is found anywhere upon the continent of Europe; while a still greater contrast occurs in the comparative extremes of heat and cold experienced on these two continents in winter and in summer. Thus, it has been observed by Humboldt that the climate of New York combines the summer of Rome with the winter of Copenhagen; while at Quebec is found the summer of Paris contrasted with the winter of St. Petersburg. In Europe the winters are warmer and the summers cooler.

This high temperature and dryness of the atmosphere prevailing in the United States, as compared with the low temperature and damp, foggy, cloudy atmosphere of the west of Europe, is extremely favorable to the growth of certain fruits and plants, particularly the apple, wheat, and the better cereals; whereas, owing to the excessive dryness of the atmosphere, English grasses require especial attention south of the latitude of Philadelphia, and are difficult of cultivation under any circumstances south of the thirty-eighth parallel. (The latitude of Washington, Louisville, and San Francisco.)

Character of Soil.—The climate of a locality is materially influenced by the character of its soil. In chalky or lime-stone districts, or where soil is sandy or gravelly, the rainfall disappears quickly by percolation, leaving the ground dry, and the atmosphere is thus rendered less damp. Localities in which such soils abound are free from all malarious exhalations. Marshy districts, on the other hand, are proverbially unhealthy, from the fact that they give rise to certain poisonous agents, either the product of vegetable decomposition, or, in accordance with another theory, an exudation from the earth favored by conditions of heat and moisture.

Sandy soils not only absorb rapidly the rain that falls, but also any noxious effluvia that may be contained in the atmosphere. They, moreover, retain their heat for a much longer time than clay soils or garden ground, and on this account they tend to prevent the sudden cooling of the atmosphere which is especially liable to occur shortly after sundown. In this manner, by modifying any sudden changes from heat to cold, sandy soils exercise a considerable influence in rendering the climate more equable, and affording an exemption from those changes of temperature so harmful to the invalid. Those localities in which the soil or subsoil is composed largely of clay, form unhealthy sites for habitation, the air being rendered damp and cold, and productive of rheumatisms, colds, catarrhs, and consumption.

Forests.—It is remarkable in the history of mankind how little has been hitherto understood concerning the beneficent influence exercised upon any locality by the near presence of forests, and the injurious effects that must inevitably follow the wholesale destruction of them, such as has been wantonly committed in the United States during the past quarter of this century. Forests serve to retain the rain in their leaves, roots, and the surrounding ground, and thus constitute natural reservoirs of water, which feed our water-courses throughout the summer. By exhaling the watery vapors absorbed by their roots from the earth, they contribute to render the air more humid, and thus moderate the extreme cold of winter and the heat of mid-summer; and when this ascending vapor comes in contact with the higher and cooler layer of the atmosphere, it becomes condensed into clouds, and these, in falling, produce frequent refreshing showers in localities which would otherwise suffer for the want of rain.

Upon the other hand, in districts that have been robbed by man of their forest covering, the land exposed to the direct rays of the sun acquires a temperature more elevated than that of the atmosphere, and, becoming heated and dusty, it is after a while deprived of all vestiges of vegetable life, and is no longer capable of sustaining a large population. Instances of the deleterious effects upon the soil and climate, and the consequent partial depopulation of entire districts, produced by the extirpation of forests, are found in the valley of the Euphrates, in China, in Northern Africa, and in very many countries bordering on the Mediterranean Sea. There exists every reason for concluding that, at no very distant period, similar changes will be experienced in Ohio, Michigan, Indiana, and other Western States, where the wholesale destruction of trees has been for years permitted, unless measures be taken to prevent these fertile regions from being rendered sterile and uninhabitable.

To the invalid the presence of forests is, moreover, beneficial in that they have a disinfecting influence upon the surrounding air, absorbing or neutralizing innumerable noxious gases and miasmatic vapors, and giving oxygen and resinous odors. Several instances are upon record where the wholesale levelling of trees has exposed a district to the direct effects of malarial poison, and thus given rise to severe and fatal epidemics; while the presence of a woodland intervening between an inhabited district and an unhealthy marsh has afforded an insurmountable barrier to this malarious influence.

Ozone.—The presence, or absence, of atmospheric ozone is thought to exercise a powerful influence upon the human organism; but our knowledge concerning the mode of action of this agent, and of the comparative quantity in which it prevails in different localities, is as yet extremely limited. It is supposed to act powerfully by oxidizing and thus rendering innocuous the essential principle of zymotic diseases and putrescent miasmata. In a similar manner, by oxidizing the hydrogen compounds of sulphur, phosphorus, and nitrogen, it possesses the power of destroying the offensive smells produced by decay of animal matter, and of thus preserving the purity of the atmosphere; on which account it has been termed "nature's great deodorizer." It is known to possess the strongest disinfecting power, and has been administered successfully as a remedial agent in the treatment of scarlet fever and diphtheria. It is soluble, to a small extent, in water, and when water is mechanically divided, so as to form spray, it is liberated in large quantities. Hence, near waterfalls, and at the sea-side [or in the neighborhood of the great lakes], where the water is driven towards the coast in the form of heavy surf, this gas is found in such abundance as to be appreciable to the sense of smell.

Elevation.—Another cause which modifies climate is the elevation of the land above sea-level; a difference of altitude being equivalent, in its effects upon temperature, to a difference in latitude. As we rise above the surface of the sea, the air becomes more and more rarefied, and the degree of heat derived from the sun's rays decreases, until at length a point is reached above which snow and ice are no longer melted. The snow-line of a given place is dependent upon the distance of the place from the equator; being very much higher in warm than in cold countries. In the Andes of South America, situated near the equator, it was found by Humboldt that the height of the snow-line is about 1,600 feet; whereas in Norway, in lat. 60°, the snow-line comes down to a level of about 500 feet, and in 80° of north latitude the surface of the earth is covered with snow all the year round. In temperate climates this progressive lowering of temperature amounts, with occasional variations, to about ten degrees for every 300 feet of vertical ascent. It is commonly considered that life on an elevation offers hygienic advantages, and this popular notion is supported by many unquestionable facts. It has long been known, for instance, that land at a height of 1,000 feet above the Campagna of Rome offers immunity from the miasms infecting the districts below ; also, that a large class of invalids obtain relief by retiring to certain moderately elevated regions of the Alps or White Mountains.

Undoubtedly the total of the climatic conditions of numerous mountain resorts is favorable, for the atmosphere of these regions being clear, dry, and bracing, and free from dust, smoke, and those organic particles which are thought to play so important a part in favoring putrefactive changes upon the earth's surface, the mental and muscular powers increase in activity and strength ; the functions of respiration are also increased, as well as the excretions from the skin and intestines; the appetite is excited and, as digestion becomes more complete, there is a proportionate gain in physical strength, and the entire organism appears revivified.

The beneficial influence of this aseptic mountain air does not prevail, however, above a certain elevation. We learn from aëronauts and mountain travellers that on ascending to very high regions they are subject to characteristic sensations and discomforts, resulting from diminution of the barometric pressure, and from the lower temperature. These symptoms, which have been comprehended under the term "mountain sickness," consist of an increased frequency of respiration ; palpitation of the heart; distension of the arteries, especially those of the head; dizziness; dimness of vision; nausea; nervous and muscular weakness, and ever-increasing difficulty in respiration which, if unrelieved, may cause death by asphyxia. These derangements are produced by imperfect oxidation of blood in the rarefied air, the proportion of oxygen decreasing as barometric pressure is diminished.

These symptoms are greatly aggravated in a very low temperature, or upon any attempt to climb or even walk about; being less severe in a warm air, or if the traveller remains perfectly quiet, as the blood demands less oxygen when the air is warm or the body is at rest. The favorable hygienic influences are therefore to be found only at moderately elevated regions, while, from the modifications of barometric pressure that prevail at very great latitudes, the blood, insufficiently supplied with oxygen, becomes impoverished, and prolonged existence is thereby rendered impossible.

Winds.—In addition to general currents which lower or raise temperature by transporting atmospheric peculiarities of one country to another, there is a great difference in the force of the wind of different localities upon the same continent, due to the topographical character of the places, whereby the climate is sensibly influenced. At a low temperature the body will be deprived of its heat at a much more rapid rate when the wind is high than when it is calm. Hence the advantage of a moderately calm climate, where the invalid, particularly one subject to bronchial irritation (to whom high wind is especially injurious), is enabled to take exercise in the open air in a comparatively low temperature.

In certain exposed and elevated regions the force and frequency of the prevailing winds is so great that trees are stunted and forced to grow to the leeward, while other localities, sheltered by high hills, possess a remarkably calm and still atmosphere, having a soothing, sedative effect upon invalids.

Deep valleys that admit the rays of the sun for a few hours only each day, are unhealthy as places of residence, for here the air, being confined, becomes loaded with damp, malarious exhalations and vapors, such as would speedily be dispersed if exposed to sunshine and free circulation of air.

VARIETIES OF CLIMATE

Irritant climates are characterized by the prevalence, during a portion of the year, of a disagreeable, penetrating wind, that deranges the nervous system, depresses the spirits, and tends to induce and aggravate many maladies. In New England, during the spring months, these winds, coming from the northeast, are raw and cold, causing rheumatism and pulmonary diseases. In England they come from the east. In Spain, and the French valleys of the Pyrenees, a hot, irritating air blows from the south; while in Italy a cold north wind, called the Tra Montana, is the cause of much discomfort to both the healthy and the diseased.[1]

Tonic climates are such as produce a stimulating, bracing effect upon the body, exciting the functions of the animal economy and producing buoyancy of spirits. This favorable, health-giving influence seems to be dependent chiefly upon moderate dryness of the atmosphere, combined with a clear, sunny sky, which favors exhalations from the lungs and skin, and permits daily exercise in the open air. The temperature of a tonic climate may either be very low, as in Colorado and Minnesota during the winter, or extremely hot, as in the Spanish Peninsula during the summer; provided only that the air be dry, its exhilarating and strengthening influence is none the less marked.

An atonic or **relaxing climate** is characterized by the habitual presence of a large amount of moisture in the atmosphere, combined with a high temperature. It tends to produce a feeling of bodily lassitude and mental depression, and also to aggravate internal congestion and inflammation. Examples of this variety of climate may be found in Florida, Cuba, the Bahama and Bermuda Islands, Rome, Pisa, and Palermo.

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[1] A similar cold north wind, which has been deprived of its moisture by passing over mountains, is, in Southern France, called the Mistral. In Texas and Arizona "Northers," as they are there called, which have lost their moisture during their passage over broad tracts of desert country, cause great suffering during their continuance.

INFLUENCE OF CLIMATE IN DISEASE

Although the beneficial influence of a change of climate has long been recognized, the hardships, which formerly attended even the best modes of travelling, prevented most invalids from availing themselves of this important agent. The use of steam as a motor power has, however, made wonderful changes in this respect, and, as one of the marked results of this improvement in travelling facilities, we see the vast watering-places that abound in Europe and the United States, and the relatively deserted state of large cities during the heated season.

The most marked effects are frequently produced by a change of residence, even though the distance be not great —such as removal from a low, swampy region to one more elevated; from the insalubrious and depressing conditions of a crowded city to the open country; from the country to the sea-shore, or *vice versa*. In the treatment of various diseases—such, for instance, as whooping-cough, asthma, intermittent fever, and affections characterized by dyspepsia—no more beneficial results can be obtained than those derived from a judicious change of air, and under its influence the action of all other remedial agents is often rendered more efficacious. In other diseases, and particularly in lung troubles, by a more complete change of climate, the malady, if threatening, may be warded off; or, if actually existing, may be cured; and even in less fortunate cases, where an unfavorable result is inevitable, the progress of a fatal disease may be indefinitely postponed and life prolonged for years, when such change is admissible. It should be borne in mind, however, that no air or climate possesses any *specific* properties by virtue of which diseases are cured; though certain localities, such as Aiken, South Carolina; Bournemouth, England; or the Isle of Pines, lying south of Cuba, derive a special character from having an atmosphere impregnated with resinous and balsamic odors, which are thought to exercise a favorable influence in certain disorders of the air-passages.

The advantage to be gained by transition from a cold and damp to a warm and dry region, or from a changeable to an equable climate, is to be ascribed in a great measure to the fact that it allows the invalid to pass a portion of the day in the open air, when, were he to remain at home, he would be shut up, perhaps for the entire winter, in the insalubrious air of artificially-heated apartments, deprived of proper exercise, and exposed to draughts in cold corridors—conditions tending to the production of indigestion, fatty degeneration of the entire muscular system, hypochondriasis, and aggravation of pre-existing disorders.

There exists, in even the most serious maladies, a natural tendency to spontaneous cure; and this tendency, which is favored by exposure to the sun and air, is checked by prolonged in-door confinement. Let the invalid be removed from the manifold depressing influences inseparable from our large cities, and placed in a climate where he can enjoy daily exercise in the open air, without incurring the risk of taking fresh colds, and the constitution is improved and the normal healthy condition is restored, often without any further treatment. There are offered, moreover, obvious advantages in a bright atmosphere and cloudless sky, while the numerous objects of interest found in Southern Europe, and especially in Italy, combine to entertain the invalid and divert his mind from cares, anxieties, and gloomy forebodings, substituting gayness and brightness of spirits—influences more potent in their effect upon the animal functions than is commonly appreciated.

When a change of climate has been decided upon, it remains for the medical attendant to determine the climate best adapted to the constitution and condition of the invalid, and the special disorder from which he is suffering.[1] Nor is it always sufficient that the simple injunction be given to "go south"; for a locality that may be beneficial to one variety of cases may be positively injurious to others. It not infrequently happens that, owing to the formation of the soil and the local surroundings, the air of one resort produces a very different therapeutic effect from that of another, although the distance between the two places is comparatively short. Thus, the climate of St. Augustine and Jacksonville, Florida, during the winter and spring, owing to their topographical position upon the low seacoast, is humid, hot, and relaxing, like that of the Bahamas, the Bermudas, and the West Indies; whereas the sand-hill regions of South Carolina and Georgia, and the high land of Colorado, possess a drier, cooler, and more stimulating air.

It is generally agreed by medical writers that the great majority of invalids suffering from general debility, pulmonary disease (whether incipient or advanced), disordered digestion, rheumatism or nervous derangements characterized by torpidity, derive the most benefit by removal to a tonic, bracing climate, which is likewise appropriate for persons suffering from no special ailment, but who seek merely change of air and relaxation from the routine of business life, or who have made imperfect recoveries after fevers.

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[1] [The late Professor Austin Flint, Sr., of New York, in conversation with the writer regarding this subject, gave the following apt illustration of his well-known good sense. Appreciating the fact that one who is obliged by ill-health to sojourn abroad is often disposed to fault-finding, and to attribute to the locality, rather than to the malady, whatever might be amiss, Dr. Flint said that, when his opinion was asked regarding the place to which an individual should go, he was accustomed to say: "Tell me where you prefer to go, and I will say whether it will be suitable for you." This would place the invalid, rather than the doctor, in the position of making the selection, and contribute greatly to his future contentment and, thereby, to the advantage to be got from the change of surroundings. Moreover, in the event of any misadventure, the doctor would not be charged with lack of judgment, as is often the case when an invalid feels that he is away from home against his will and is in no mood to adapt himself to circumstances.]

The atonic, sedative climates, on the other hand, which commonly disagree even with persons visiting them in good health, prove beneficial chiefly in certain diseases of the nervous system characterized by excitability and irritability, but unassociated with much debility; in the debility of old age in which an enfeebled circulation fails to supply the requisite animal heat, and in certain affections of the lungs accompanied by a hard, irritable, or spasmodic cough, with scanty, viscid expectoration.

HEALTH RESORTS

The principal sanitaria located in the southern portions of Europe and North America are resorted to only from November until June, invalids being then compelled, by the relaxing, oppressive heat, to return north, where, during the warm months, the weather is generally propitious. If, however, a permanent abode is desired where the same favorable influences prevail throughout the year, it is doubtful if any place enjoys a greater hygienic preeminence than the islands of the Eastern Atlantic, which were celebrated even among the ancients for their mild and equable climate. These islands occupy a much more favorable geographical position than those of the Western Atlantic, while their lofty conformation and luxurious vegetation tend to influence their climate and render them much cooler in summer. They consequently present very great advantages over the best resorts in Europe or America.

The islands of *Madeira* and *Teneriffe* have long been held in high estimation on account of their exceptionally favorable climatic conditions, and it is improbable that any health-resort can ever be found approaching nearer to perfection, as a place of permanent residence, than the town of Oratava, situated upon the latter island. The characteristics of this place are its mild, equable temperature, its freedom from epidemic diseases, and from fogs and frosts, and the rare occurrence of winds and storms. The mean temperature of the five cooler months (November to March) is 64° F.; that of February (the coldest month) being 62.1° F., and that of the three warmest months (June, July, and August) being 77° F. The mean temperature of the five winter months at Rome and Nice is 50° F.

Oratava enjoys not only a mild winter and cool summer, but there is also found remarkable equality of temperature during both day and night. A high mountain range protects the town from the hot currents proceeding from Africa, and the heat of summer is, furthermore, tempered by the sea-breezes that set in during each forenoon, and by the vapors from the Atlantic, which serve to intercept the direct rays of the sun, so that the early hours of morning differ only 6° to 9° F. from the heat of mid-day. The average number of rainy days is 45, that of Rome being 114, and the barometer stands almost invariably at 30.12 inches. In this climate of perpetual spring the invalid can live throughout the year in open air, and under most favorable hygienic conditions.

In pulmonary affections, especially, the sufferer, freed from the depressing influences of artificially-heated and poorly-ventilated apartments, and no longer exposed to the impure emanations inseparable from large cities, soon gives evidence of the revivifying effect of a pure, mild atmosphere and sunny sky. In cold, humid climates, however, great care may be taken to maintain within doors an equable temperature, else the enfeebled lungs are inevitably exposed to cold draughts, sudden atmospheric changes, and irritable winds—adverse influences which either interfere with recovery or aggravate the original complaint—while the invalid, deprived of exercise, becomes depressed and hypochondriacal, and the supervention of dyspepsia, or of some other new disorder, serves to dispel all hopes of improvement. In a favored climate, however, like that of

Oratava, the lungs, relieved of all extra labor, obtain fair play and that partial rest so necessary to enable the animal economy to resume its normal functions and throw off disease. In appropriate cases, where the disease is not too far advanced, the spirits speedily revive by the change; cough and expectoration diminish; night-sweats abate, and a favorable prospect is held out of gradual, spontaneous recovery, which, in a fair proportion of cases, is ultimately realized.

It is only in exceptional cases, however, that any such radical change of climate is essential to effect a cure, the great majority of cases obtaining sufficient benefit from the protection derived through resort to the more accessible sanitaria of Europe and America. Of these the watering-places of Southern Europe offer superior advantages in the way of hotel accommodations, hygienic cookery, society, picture-galleries, theatres, club-rooms, and other sources of mental diversion—all valuable adjuncts in the treatment of the despondent, depressed invalid. The absence of such sources of diversion in American resorts, combined with their lack of easy accessibility and the small degree of attention paid by hotel proprietors to gastronomical science, formerly rendered them unattractive to visitors, especially to those whose digestive functions are imperfectly performed. Within a few years, however, the revolution in the character of some of the larger health-resorts of the Southern States, and the improved facilities for travel, have served to divert, to a large extent, the tide of European travel. The invalid can now travel in one comfortable vehicle from Boston to Florida within but little over twenty-four hours' time; while at the more frequented sanitaria are commodious hotels, well-furnished and capable of supplying a sound, well-ordered repast, comparing favorably, as regards variety and quality of food, with the best hotels of the North.

In choosing a health-resort, we should, then, endeavor to ascertain, as far as possible, the special circumstances influencing different localities; such as altitude, neighborhood of the sea, character of soil, amount of rainfall, shelter from disagreeable winds, and other factors. We can here give only a brief summary of the chief features of some of the most noted sanitaria accessible to Americans, premising by the statement that published accounts are in many instances meagre and unsatisfactory, and are not based upon careful meteorological observations.

Asheville, North Carolina, may be mentioned as the type of those moderately dry, tonic sanitaria, occupying the mountainous districts of North Carolina, Georgia, and Eastern Tennessee, which derive special character from an altitude much higher than that of the other resorts of the Southeastern States. This high situation—more than 2,000 feet above the sea level—offers a magnificent climate during the autumn and spring, and tempers the heat of summer to such an extent that invalids can remain here with comfort throughout the year. The mean temperature of the winter months is low, however, as compared with more southern localities.

[*Warm Springs*, North Carolina, but a few miles west of Asheville and on the picturesque French Broad River, is a little less elevated than Asheville and, in addition to its thermal waters, has the advantage of protection afforded on the west, north, and east by the mountain range.]

Aiken, South Carolina, has for several years enjoyed a high reputation for salubrity. It is very attractively situated on the brow of a hill, at an elevation of six hundred feet above the sea, and is surrounded by immense evergreen pine forests. Its climatic characteristics are its pure, tonic, exhilarating air, and its absolute freedom from malarial affections; the loose, porous soil secures good drainage and serves to render the air dry. The mean temperature of the months of November, December, and January is 48.53° F., that of Asheville being nearly eight degrees colder. In its physical qualities the climate of Aiken resembles, in all essential particulars, that of

Mentone, Nice, Pau, and the other resorts of Southern Europe, but is, like other American resorts, less equable, although enjoying greater immunity from rainy weather. This town is well supplied with excellent hotels and boarding places, and is suitable to the generality of invalids suffering from pulmonary complaints, derangement of the digestive system, or general debility without any special ailment. The season extends from November to April inclusive.

Thomasville, Georgia, has become extensively and favorably known as a resort for consumptive patients. Like Aiken, it has a high elevation, with a loose, sandy soil, in the midst of evergreen pine forests, and is said to possess a winter temperature somewhat milder, but less dry, than that of Aiken.

Florida.—This flat peninsula, occupying a low latitude and, for the most part, raised comparatively but few feet above the sea, presents a sunny, genial climate during the winter months, considerably warmer and more humid than the Northern Mediterranean resorts. *St. Augustine* is finely situated upon the coast, and is rendered especially attractive by its remarkable historical associations. *Jacksonville*, near the mouth of the St. John's River, offers superior hotels and refined society. The atmosphere of these two localities is warm and moist, and of special benefit in certain nervous and bronchial affections. Owing, however, to the mixture of land- and sea-air, and to other local influences, consumptives are usually advised to repair to the more elevated towns upon the St. John's River, such as *Magnolia*, *Palatka*, and *Enterprise*, where the climate is still milder, but less variable and humid. The malarial character, however, of this entire district renders it an unsafe abode for visitors during the summer months.

Nassau, upon New Providence, one of the Bahama Islands, is charmingly situated near the confines of the tropics, and possesses, probably, the most equable climate of any of the American sanitaria; the temperature for a period of years not having risen above 88° F., nor fallen below 60° F. During the winter months, bright, clear weather, with little or no rain, abounds, the only drawback being the humidity of the atmosphere and the somewhat relaxing character of the climate, common to most semi-tropical resorts. A public library, an excellent hotel, and fine, well-kept roads, all contribute to the diversion and comfort of strangers.

San Antonio may be considered the best-known resort of the region which includes the high table-lands of *Texas* and *New Mexico*, and is now visited by a large number of searchers for health. Its distinguishing climatic feature is its mild, dry, stimulating air. It is subject, however, to great range of temperature, and being quite unprotected by mountains from the cold, dry, piercing north winds which sweep the continent, an invalid will be frequently compelled to keep within doors during winter.

The climate of the highly-elevated district of *Colorado*, occupying the upland plateau of the Rocky Mountains, has become favorably known, owing to its beneficial influence upon many classes of invalids. While congenial and exhilarating to persons in sound health, it is especially recommended during the winter to those suffering from incipient pulmonary affections, when the local disease is not extensive, and for disorders originating in imperfect nutrition or from long-continued overwork and mental anxiety. This region, so dissimilar to any of the European sanitaria, owes its climatic characteristics to its peculiar geographical situation; the principal towns being located at an elevation of 5,000 to 6,000 feet above the sea-level, which, combined with the distance from large bodies of water, tends to produce an extremely dry and bracing atmosphere. Although the winters are quite cold (the average temperature for a period of five years being 29.1° F.), in this rarefied atmosphere, with an almost uninterrupted prevalence of bright, clear sky, the cold does not form a deleterious or even disagreeable feature, since it is counterbalanced by the increased heat derived from the sun; the bracing, invigorating influence of the mountain air, and the shelter from strong winds afforded by the adjacent, lofty mountain-ranges. No rain, and but little snow, fall during the winter, the ground being for the most part bare. Severe storms are of very rare occurrence; but abrupt, extreme alternations of temperature are common. As a summer residence it is healthy and safe. The principal resorts are *Denver; Manitou,* near Pike's Peak, noted for its thermal springs and charming situation at an altitude of 6,370 feet above the sea-level; *Idaho Springs,* having an elevation of 7,540 feet; *Colorado Springs* and *Pueblo.*

Minnesota.—The vicinity of St. Paul, on the Upper Mississippi, has long been known as affording good climatic conditions for many cases of illness. The distinctive feature is a dry, cool atmosphere during the entire year. Although the climate acts powerfully as a tonic, the intensity of the cold in winter prevents it being of service to those whose circulation is poor and whose vital heat is not kept up.

California possesses great diversity of climate, but that of the southern portion of the State (which is the resort of invalids) is probably the most favored of all North America, and is as capable of meeting the requirements and peculiarities of every variety of disease as any locality in Europe. The situation of *Santa Barbara,* embosomed in a valley overlooking the ocean and sheltered from cold winds by mountain-ranges which hem it in upon the north, renders it a remarkable winter resort; its climate being equable, mild, and relatively dry. *San Diego,* also upon the coast, bears a close resemblance in its climate to *Santa Barbara,* the mean temperature of each place being 53° F. for the month of January. The climate of *San Bernardino,* situated in the interior, at an altitude of 1,000 feet, offers the advantage of a drier atmosphere than that of the last-mentioned resorts and, being cooler in summer and enjoying an immunity from fogs, which then prevail in the vicinity of the sea-coast, affords, throughout the year, a genial, salubrious residence. The *Ojai Valley*, about forty-five miles northeastward of Santa Barbara, is considered by Californian physicians to be a more favorable residence for persons having pulmonary troubles than Santa Barbara itself, and many persons from eastern States have resorted to it with benefit.

[The *Adirondack region* of New York is now the resort for many cases of pulmonary disease. Its comparatively high altitude ; accessibility for those whose homes are at the East ; freedom of its atmosphere from pathogenic germs ; conditions which encourage open-air life, even in winter, and the existence of a well-conducted hospital for this class of maladies, have all helped to make it desirable.]

It is a serious error, however, to imagine that diseases in all stages are amenable to a change of climate. It is well to understand that when there exists advanced chronic disease of any organ, the fatigue and excitement incident to a long journey may often produce, in a susceptible person, attacks of acute fever, and, possibly, some new inflammatory affections which may more than counterbalance any possible benefit derived from a short residence, even in the most appropriate climate. Unfortunate is the lot of the expatriated invalid when left unattended in France or Italy, where an unfamiliarity with language and customs, combined with physical helplessness, render him a feeble victim to the cupidity of unscrupulous landlords, and subject him to numerous petty annoyances, not the least of which is the consciousness that even his death will afford but a pretext for new and preposterous claims. It will often happen, therefore, that the extreme physical weakness or susceptibility of an invalid, or the advanced character of the disease, or a lack of pecuniary means, renders any decided change of climate inexpedient or impracticable. Such a one may be reminded that, even in his own home, something can still be done to mitigate urgent symptoms and prolong existence, by taking the necessary precautions to maintain within doors an equable temperature and thorough ventilation, and indulgence in such exercise as his strength and the weather may permit. Even when a fatal termination is inevitable, that result will be awaited with less trepidation if the tranquillizing assurance can be had, that the last days are to be cheered by home comforts and the consoling presence and attention of those rendered dear by ties of kindred and friendship.]

MINERAL WATERS

[Closely allied with the subject of climatic influences, as accessory measures in therapeutics, is the use of natural mineral waters. It may be well, therefore, to consider here their general composition and the conditions under which they may be useful.]

[Mineral waters are subject to the same rules as other chemical combinations. They contain ingredients in varying proportion, nearly all of which are already well known. They vary in medicinal value, as do other medicines, and for similar reasons. Let us remember that nearly all springs in this country are but repetitions of those known beyond the Atlantic; that their value in various diseases has been clearly defined, and that, as a rule, we have only to consult an accurate analysis of a water to determine, with considerable certainty, in what diseases it will prove beneficial.

COMPOSITION AND CLASSIFICATION

The most frequent chemical ingredients of mineral waters are: Chloride of sodium, carbonate of sodium, sulphate of lime, sulphate of sodium, sulphate of magnesium, iodide of sodium, carbonate of iron, carbonic acid, sulphuretted hydrogen, oxygen, and nitrogen.

The unusual ingredients are bromide of sodium, arsenical salts, fluorides, free sulphuric acid, and organic compounds—such as hydrosin.

Since almost all mineral waters contain some one ingredient far in excess of every other, it becomes easy to formulate a classification based on this fact, and thus we have:

Alkaline waters (alkaline carbonates in excess).

Saline waters (chloride of sodium in excess).

Sulphur waters (so named from the presence of sulphuretted hydrogen).

Chalybeate waters (some salt of iron prominent).

Purgative waters (sulphate of sodium or other purging salt in excess).

Calcic waters (carbonate or other salt of lime prominent).

Thermal waters (characterized by high temperature).

It has been well determined by observation, both in this country and in Europe, that the waters of each of these classes possess properties peculiar to themselves, for the relief of various maladies; and, although the waters of separate classes may resemble each other in some special characteristic, yet in their ultimate effects they are quite distinct. It becomes desirable, then, to name the prominent springs in this country and in Europe pertaining to each class, together with a condensed statement of their chemical constitution and therapeutic action. To name all or give detailed analyses would be impracticable, since there are over two hundred and fifty medicinal mineral springs, more or less famed for their curative virtues, in the United States alone.

Alkaline Waters.—The special characteristic of these is the preponderance of alkaline carbonates of sodium, potassium, and magnesium. The most noted alkaline springs of the world are those of *Vichy*, France, containing twenty-six grains of carbonate of sodium, two grains of carbonate of potassium, one grain of carbonate of magnesium, and fourteen cubic-inches of carbonic acid gas in each pint. There are several springs at Vichy—the Grande Grille, Célestins, Chomel, Mesdames, etc.—the waters of which are bottled and may be found in the principal cities of the world. The waters of *Hauterive* and *Cusset-Vichy*, a few miles distant, are of the same character. In Germany there are the springs of *Fachingen* and *Ems*, also decidedly alkaline waters. The only spring in this country which represents this class is that of *Bladon*, in Alabama, containing five grains of carbonate of sodium in the pint.

Uses.—The diseases to which these waters are applicable are uric acid gravel, gout, chronic gastritis, diabetes (mellitus), and gall-stone.

Saline Waters.—The prominent constituent is chloride of sodium. It must, however, be remembered that in different springs there are various other constituents which modify or reinforce the action of this agent so as to produce an effect entirely distinct from that of an ordinary solution of salt. Waters of this class increase the action of the intestine and prove aperient or cathartic according to their concentration and the quantity taken. They also promote flow of urine and secretion from mucous membranes. They stimulate digestion, augment the flow of bile, and exercise a marked influence over processes of change in the lymphatic system.

The mild saline waters, containing considerable carbonic acid gas and a small proportion of alkaline salts, are the most agreeable to the taste of all mineral waters. The famous table waters—*Selters* and *Apollinaris*—which blend so well with wine, belong to this division. In this country we have the unsurpassed *Saratoga* waters. They contain in each pint from thirty to sixty grains of common salt, from five to fifteen grains of the alkaline carbonates, and a like proportion of carbonate of lime, with small quantities of sulphates, iodides, and bromides. There are about twenty different springs at Saratoga, all rivals for popular approbation, and each proprietor claims superior excellence for his own; while the waters of the springs vary somewhat in the amount of each ingredient, they possess similar medicinal properties. An exception should be made as to the Columbian, Pavilion, and Hamilton springs, each of which contains an active proportion of carbonate of iron.

We have not mentioned above an ingredient of the water which contributes largely to its popularity and efficacy—that is, carbonic acid gas, which is present in the proportion of thirty to sixty cubic-inches per pint; indeed, the quantity is so large in the Geyser and Spouting springs that the water is forced many feet into the air by its pressure. Only a few miles distant from Saratoga is the village of *Ballston*, where there are several springs identical in character and medicinal effect with those just mentioned.

Other saline waters in the United States, which may be used internally, are those of the *Charleston Artesian Well*, S. C. (nine grains chloride of sodium and seven grains of carbonate of sodium per pint), and *Albany Artesian Well*, N. Y. (sixty-three grains of chloride of sodium, seven grains of alkaline carbonates, and twenty-eight cubic-inches of carbonic acid gas per pint).

Uses.—The stronger saline waters are used both internally and in the way of baths, the latter mode of administration being almost restricted to the very strong saline waters—brines—known and highly favored in Germany as *sool bäder.* These natural earth-brine baths prove of exceeding service in the treatment of scrofula, especially as it manifests itself during childhood. They are also beneficial in chronic rheumatism and chronic gout, when the person is anæmic. Paraplegia and hemiplegia are frequently benefited in a marked manner by the stimulant action of these baths on the skin, nerves, and blood-vessels when resort to them has not been too long delayed.

The mild saline waters, taken internally, are valuable in various morbid conditions of the liver. Jaundice, due to catarrh of the bile-ducts, is relieved by them, and the formation of gall-stones prevented. That condition known as engorgement of the liver or abdominal plethora, occurring in persons of full habit, is also favorably influenced by their use.

Sulphur Waters are so called because of the presence of considerable sulphuretted hydrogen. Aside from this gas these waters contain exceedingly variable ingredients, which, if they alone were considered, would, by their predominance, assign some of the springs to another class. Thus, we have alkaline sulphur waters, in which the alkaline carbonates are abundant, muriated sulphur waters, which contain considerable chloride of sodium, and calcic sulphur waters, which are impregnated with salts of lime.

Sulphuretted hydrogen, as taken into the stomach in moderate quantities in a mineral water, increases the activity of the intestines and augments perspiration. The sulphur contained in it permeates the tissues and blood-vessels in a peculiar manner, and there induces nutritive changes usually termed "alterative." Although this gas thus exercises a decided influence in the cure of diseases, especially those of the skin and mucous membranes, yet in the prescription of these waters special attention should always be given to the amount and properties of the solid ingredients. Certain sulphur waters are designated as "white," "blue," "yellow," or "red," according to their color. This depends on the deposits which occur after the water has escaped from its source. In white sulphur water the precipitate is sulphur; in yellow, it is polysulphurets; in blue, it is supposed to be an impalpable powder of slate; and in the red, a deposit of oxide of iron or the development of microscopic algæ of a red hue is presumed to be the cause. In some waters of this class a peculiar organic substance is found, called hydrosin or barégine, which seems to give to these waters a sedative or quieting effect on the vascular system. Its exact medicinal value has not, however, been determined.

In this country, as in many others, there is a long list of sulphur waters. Indeed, when we consider the small quantity of sulphuretted hydrogen necessary to impart to water its characteristic odor, and that it is frequently evolved by the decomposition of organic substances on the surface of the earth, we need not be surprised that in nearly every valley there flows a so-called sulphur-spring. Such waters are, however, seldom medicinal, and, aside from their peculiar odor, possess no other qualities than those of ordinary water.

Of muriated sulphur waters (those in which chloride of sodium is a prominent constituent) we have several valuable ones. Such are the *Upper* and *Lower Blue Lick;* the *Paroquet*, and *Louisville Artesian*—all in Kentucky; also the *Columbia*, in New York, each containing from thirty to sixty grains of salt in the pint. There are also springs which, in addition to common salt, contain an active proportion of purgative salts, like the *French Lick*, in Indiana; or they contain purgative salts with lime salts, like *Sharon*, New York; *Greenbrier White Sulphur*, Virginia; and *Salt Sulphur*, West Virginia. Again there are sulphur waters in which the salts of lime alone predominate, as *Chittenango*, and *Clifton*, New York, or the *Yellow Sulphur*, Virginia. Occasionally there is a water found containing an active proportion of alkaline, saline, and purgative salts. Such is the *Borland* spring of West Virginia. Least frequent of all are waters containing hydrosin, like the *Red Sulphur*, West Virginia, a water the peculiar properties of which seem to depend entirely on this constituent. Of thermal sulphur waters, there are the *Calistoga*, *Paso Robles*, and *Santa Barbara*, California; *Middle Park*, Colorado; and *Warm Springs*, North Carolina.

The principal cold sulphur waters of Europe are those of *Nenndorf*, and *Meinberg*, Germany; and the most noted thermal sulphur waters are *Aix-la-Chapelle*, Belgium; *Aix-les-Bains*, Savoy; *Baréges*, and *Bagnères de Luchon*, France.

Uses.—Sulphur waters are valuable in the treatment of gout and chronic rheumatism, especially if they are warm waters; and it is probable that they cause favorable results as much by this element of heat as by virtue of the solid ingredients. In chronic poisoning by lead, or by other metals, sulphur waters, used internally, prove exceedingly beneficial; the sulphur forming soluble salts with the metal, which then are eliminated through the skin and kidney.

Chalybeate Waters have iron as the principal constituent, usually present in the form of a bicarbonate, and those waters are most easily borne which contain considerable carbonic acid gas. In this way iron enters the blood more readily and exerts its tonic influence more certainly than in almost any other. The number of good iron-springs here or in Europe is exceedingly limited. Why this is so is readily understood when we consider the requisites, viz.: First, the water must contain sufficient iron to be decidedly medicinal. Second, it must contain considerable carbonic acid gas. Third, there must be very little of other constituents. A popular spring of this kind is that of *Schooley's Mountain*, New Jersey, which is said to be a pure chalybeate. *Cooper's Well*, Mississippi, has enjoyed much repute in the South for many years. It contains nearly half a grain of iron in each pint, with salts of lime, magnesium, and sodium. *Rawley Spring*, Virginia, is a good chalybeate. The best chalybeates in Europe are those of *Schwalbach* and *Pyrmont*, containing, respectively, one-half and two-thirds of a grain of carbonate of iron per pint.

The *Alum Waters*, of Virginia, are included under chalybeates, although they are not such in the sense of pure iron-tonics. They are really alterative waters of a peculiar and complex character. They contain from half a grain to a grain of iron in each pint, together with considerable alumina and free sulphuric acid. They have been found especially valuable in scrofula, and in diseases of the skin depending on a scrofulous constitution. The principal springs of this kind are the *Rockbridge*, *Jordan*, *Bath*, and *Bedford-Alum*—all in Virginia.

Uses.—The effect of these waters is to increase appetite, promote digestion, stimulate activity of the heart, and, when persons are anæmic, they bring back a rose-hue to the cheeks.

Waters of this kind are useful in all cases of impoverished blood, whether depending on dyspepsia, derangement of menstruation, exhausting diseases, or any cause whatsoever. They are also frequently resorted to by persons who have undergone, at other springs, a course of reducing treatment with alterative mineral-waters. When, at the close, the person is relieved of his malady, though pale and anæmic, he may go to some good chalybeate spring, drink the water for one or two weeks, and be restored to accustomed vigor.

Purgative Waters, as the name implies, contain constituents which act as cathartics or aperients. These effects are more or less pronounced according to the preponderance of sulphate of magnesium, sulphate of sodium, or sulphate of potassium, and the way in which these are associated with other ingredients—such as the alkaline carbonates, sulphate or carbonate of lime, or some salt of iron, either of which tends decidedly to modify their action. These waters are bitterish in taste, and, by Germans, are termed *bitter wasser*. This taste is, however, decidedly mitigated by the presence of considerable carbonic acid.

The principal purgative springs of this country (the *Crab Orchard*) are located in Kentucky. They contain thirty-three grains of purgative salts in each pint. By boiling down the water a valuable purging salt, known as *Crab Orchard Salt*, is obtained. There are also the *Estill* springs, containing thirty-two grains, and the *Harrodsburg* springs, containing twenty grains of purgative salts per pint. Both are situated in Kentucky. The only other purgative spring of note is that of *Bedford*, Pennsylvania, which, however, is, as a rule, aperient only because of the considerable amount of carbonate of iron.

European purgative waters most frequently for sale in bottles are *Friedrichshall* (eighty-six grains of purging salts to the pint); *Kissingen* (eighty-five grains); *Pullna* (two hundred and twenty grains); *Hunyadi Janos* (two hundred and sixty-six grains). The last-named is doubtless the best of these waters, containing a large amount of purging salts. In addition there is considerable carbonate of sodium, chloride of sodium, and carbonate of lime, which tend to render its action mild. [*Apenta* water, more recently introduced, is from the same region as the Hunyadi Janos, and has about the same constituents.]

Uses.—These waters are mostly used as substitutes for the disagreeable-tasting saline purgatives of the shops; and although containing the same purging salts, yet these are so combined with other ingredients that they act more mildly, and the taste is but little noticed. Persons do not go to the spring to drink this sort of water, but it is bottled and may be found in nearly all pharmacies.

These waters are sometimes used in that condition known under the somewhat vague name of abdominal plethora. This occurs most frequently in persons who are generous livers, and who use malt liquors and wine frequently. It is associated with constipation, a loaded tongue, and sluggish hepatic action. In such cases a short course of these waters frequently relieves all the symptoms in a short time, and reduces the previously corpulent person to a normal weight.

Calcic Waters.—The principal ingredients of these waters are salts of lime. The most prominent springs of this class in the United States are *Eaton Rapids*, Michigan, containing five grains of lime salts and two cubic-inches of carbonic acid gas in each pint; *Sweet Springs*, Virginia, containing five grains of lime salts and eleven cubic inches of carbonic acid gas; and *Bethesda*, Wisconsin, having two grains of lime salts in each pint. The last-named spring has a widespread reputation for the relief of those diseases to which waters of this kind are applicable. The most esteemed calcic waters of Europe are *Contrexeville* (twelve grains of lime salts to the pint) and *Wildungen* (three grains of lime salts and a large quantity of carbonic acid gas to each pint).

Uses.—Some time ago waters of this kind were thought to possess little value. However, it is found that waters containing carbonate of lime and other alkaline carbonates, with considerable carbonic acid, are exceedingly valuable in irritability of the bladder depending on chronic inflammation, and for gravel, either of the kidneys or bladder. They also prove palliative in saccharine diabetes. Cases of dyspepsia, accompanied by pain, are also frequently relieved by their use.

Thermal Waters.—The chief curative agent in these waters is heat, and the good results obtained by their use depend, almost entirely, on the appreciation of this fact and on its appropriate application. It is often asked, "Why not, then, use hot water at home?" For the simple reason that it is impossible to obtain hot water there in sufficient quantity and of continuous temperature. Imagine a person trying to imitate a single bath, such as may be had at the Hot-Springs. For this purpose, hundreds of gallons of water must be heated to a temperature of 150° F., and it must be maintained in a reservoir at exactly that temperature. Then it must flow in a stream into and out of the bath-tub, so that the temperature of the water in the tub is kept at exactly the desired degree continuously—not vacillating from hot to cold and from cold to hot, as in an ordinary bath. Then, in addition, there must be a perfect mill-race of hot water to supply the vapor-room. The expense of heating so much water to such a degree, and the utter impracticability of retaining it there, are sufficient answers to those who think lightly of thermal baths. Still more is it impossible to imitate an immense warm piscina-bath, containing thousands of gallons of water, such as the one found at the Warm-Springs, Va., and at other noted resorts.

There are a number of valuable thermal-springs in this country, but at few of them are the proper auxiliaries, piscina-baths, douches, etc., such as could be desired. The *Hot-Springs* of Arkansas (93° F.–150° F.), *Hot-Springs*, Va. (78° F.–110° F.), and *Warm-Springs*, Va. (98° F.), occupy a deservedly high place, though they are but slightly mineralized, and in Europe would be termed indifferent thermal waters. The *Warm-Springs*, N. C. (97° F.–102° F.), contain sulphuretted hydrogen, carbonic acid, and sulphate of lime. The *Idaho Hot-Springs* (85° F.–115° F.) contain three grains of carbonate of sodium, three grains of sulphate of sodium, and two grains of sulphate of magnesium to the pint. The *Paso Robles Hot-Springs* of California (112° F.–122° F.) contain considerable chloride and carbonate of sodium, and a large amount of sulphuretted hydrogen and carbonic acid gas.

The prominent thermals of Europe are *Gastein*, in Austria (87° F.–160° F.), *Toeplitz*, in Bohemia (120° F.), *Schlangenbad*, in Nassau (82° F.–89° F.), and *Plombières*, in France (125° F.).

Uses.—The diseases to which thermal-baths and douches are specially applicable are chronic rheumatism, chronic gout, paraplegia, neuralgia, false anchylosis, and certain diseases of the skin (psoriasis, lichen, etc.). In syphilis they promote cure by aiding appropriate internal medication.

THERAPEUTICAL USE

Chronic Rheumatism.—The mineral-water treatment of this disease consists, almost exclusively, in the employment of thermal-baths (95° F.–100° F.), thirty in succession, at intervals of one or two days, according to the effect. When there is decided stiffness of the joints, the hot douche (106° F.–120° F.) is a valuable auxiliary. It is, for the most part, indifferent whether these baths are of highly-mineralized water or not. In some cases in which there is decided want of tone in the skin, the salt-thermals seem preferable because of the decided stimulation of the skin which results from their use.

Syphilis.—There are no mineral waters that cure this malady; yet there are many, which, conjoined with the use of appropriate medicines, aid most decidedly in the removal of the diseased condition of the system. Sulphur waters, saline waters, thermal waters—all have been successfully used in this disease. Perhaps the best results have, in this country, been obtained at the Hot-Springs of Arkansas, though other thermal-baths, such as the Virginia Hot-Springs, and those of Paso Robles, California, would doubtless prove equally efficacious.

Chronic Metallic Poisoning.—The most frequent form under which this is presented is the paralysis of painters and workers in lead. The most efficacious are the sulphur waters, conjoined with the use of warm or hot-baths.

Diabetes Mellitus.—Decided benefit has resulted in many cases from the systematic use of alkaline or calcic waters.

Chronic Dysentery.—It has been claimed (and doubtless with truth) that the alum-waters of Virginia have cured a number of cases of this disease.

Scrofula.—For the relief of this bad habit of body, especially in young children, next to cod-liver oil there is nothing superior to an appropriate mineral water; and it is frequently desirable to alternate mineral-water treatment with cod-liver oil. The waters most applicable in these cases are the strong salines used in the way of brine-baths, and it is this kind of waters that are almost exclusively employed abroad. We have, however, in the Virginia alum-waters, a sort little known in Europe, and these have long had considerable reputation for the cure of scrofulous diseases.

Chlorosis.—Chalybeate waters are a valuable remedy in this condition, when associated with other and appropriate medicines.

Paralysis.—Certain cases of paralysis following exhausting diseases, such as diphtheria, typhoid, cerebro-spinal fever, tedious confinement, etc., are often much benefited by proper use of thermal-baths and douches; but graver cases, in which pronounced changes have taken place in the tissues composing the nervous system, are rarely benefited.

Neuralgias.—These painful affections, when due to local irritation of nerves and nerve-sheaths, are sometimes cured in an unexpected manner by the use of thermal-baths or douches; thus it is often serviceable in cases of sciatica of long standing. It is, however, very difficult to decide in advance which cases will be benefited, and a trial of the water is the only test.

Chronic Laryngitis.—Mineral waters prove efficient in many cases of this malady. The waters most appropriate are those of the sulphur class rich in sodium, and alkaline waters containing a great deal of chloride of sodium. The European waters which have acquired the most decided reputation are those of Ems, in Germany, and Eaux Bonnes, France. The water in this country which will probably yield the best result is that of the Red-Sulphur Spring, of Virginia.

Chronic Bronchitis.—One of the most reliable waters in this disease is the Red-Sulphur, of Virginia. If the patient is scrofulous the saline-sulphur waters are preferable.

Dyspepsia.—In that form of the disease called acid dyspepsia, alkaline mineral waters prove of especial utility. When the case is one of flatulent dyspepia, and is attended with evolution and belching of large quantities of gas, saline waters yield the best results.

Saratoga waters, containing considerable chloride of sodium and sufficient alkaline carbonates, are well adapted to most persons troubled with this malady.

Chronic Gastric Catarrh.—For its treatment the strong alkaline waters, like Vichy, are mostly employed and prove exceedingly beneficial. Alkaline purgative waters, such as Carlsbad and Marienbad, are also curative.

Constipation.—It is popularly well-known that one of the best remedies for this condition is the ingestion of a glass of ordinary water immediately on rising in the morning. Much more is it the fact if an appropriate, mildly-aperient mineral water be used. The water tends to increase secretion by the mucous membrane of the intestines and augment their expulsive action. For this purpose Saratoga or Blue-Lick water is exceedingly appropriate, while, in some instances, mild purgative waters, such as Carlsbad, may be employed.

Engorged Liver.—For the relief of this malady there is no remedy superior to an appropriate mineral water. A saline sulphur water may be used, or an alkaline purgative water ; and either will, as a rule, give very beneficial results in a short time.

Gall-Stones.—For the removal and prevention of gall-stones there is no remedy equal to a good, strong, alkaline mineral water, like that of Vichy. Carlsbad, an alkaline purgative, and Saratoga, of the alkaline-saline class, will also yield satisfactory results.

Gravel.—For the relief of uric acid and oxalic acid gravel, alkaline water should be employed, like that of Vichy or some similar water. In cases of phosphatic gravel, the calcic waters, rich in carbonic acid gas, should be given.

Catarrh of the Bladder is often relieved in a marked manner by the use of mineral water. The kinds most appropriate are the mild calcic or alkaline waters.

Dysmenorrhœa, depending on uterine engorgement, is often benefited or cured by the internal administration of mineral water. That which proves most serviceable is an alkaline water of moderate strength, or an alkaline-saline water ; although water of some other kind will frequently produce a favorable result. Dysmenorrhœa arising from any other cause will not be relieved by mineral water.

Diseases of the Skin.—The principal mineral-water treatment of lichen and psoriasis is by warm baths and the internal administration of saline-sulphur water. The baths seem to act all the better if they be of the thermal-sulphur variety. Baths are frequently continued for a long time in these diseases, until a bath-eruption (called by the French *la poussée*) is produced. Baths are then discontinued, and when this artificial eruption disappears, so does the original—never to reappear. In pityriasis, baths of sulphur water, and the internal use of it, are the remedy. For scrofulous skin diseases the saline and saline-sulphur waters are used. In syphilitic skin diseases baths and internal use of waters are only adjuncts to appropriate internal medication, which they reinforce and render curative, often in a most remarkable manner.

Contractions of Muscles, and Stiffness of Joints, when not associated with organic changes and adhesions of bone, are frequently relieved by a well-directed course of thermal baths and douches.

Old Wounds.—In some instances, after a wound has healed, it reopens, closes, and opens again. This may be due to a retained piece of ball or shell ; to a fragment of clothing, or a splinter of broken bone. Under such conditions a series of thermal baths and douches often produces excellent results. A free suppuration is caused about the seat of the foreign substance, it becomes loosened, finds its way to the surface, is discharged, and the wound then heals permanently. It is for cases of this kind, and for cases of necrosis, paralysis, rheumatic contraction, etc., that the military establishments of France, Germany, and Austria have special hospitals at some of the famous thermal springs.

MISCELLANEOUS OBSERVATIONS

In selecting a place of resort we should remember that, in addition to the proper medicinal water, the advantages of location, society, etc., should be considered. The place should be elevated, so as to be free from malaria and noxious vapors, and possess a cool summer temperature. The sanitary conditions of the hotel should be unexceptionable (a subject too little regarded by many hotel proprietors).

The society should be agreeable; for some it is better that gayety abound, for others that there be quiet.

The usual season at the springs commences from the 1st to the 15th of June, and closes on the 1st of October. During this time all resorts are open to visitors. A few, however, are prepared to entertain guests throughout the year.

Rules for drinking the water are comparatively simple. It should always be taken on an empty stomach, and about an hour should elapse before a meal. The usual way is to repair to the spring on first rising and there to drink, slowly, a glass of the water; then to promenade for fifteen minutes; then take another glass and promenade again; then, in some instances, and of some waters, another glass may be taken. The exact quantity will vary according to the strength of the water and the peculiarities of the disease. One thing is always to be remembered—never to deluge the stomach with large quantities of the water, or make experiments as to how large a quantity can be drank. When a mineral water is being used, the patient should eat sparingly of good, wholesome food; but all pastry, highly-seasoned sauces, etc., should be avoided. Frequently it is exceedingly difficult to limit one's self to plain fare, especially as the change of place, mountain air, and the mineral water increase appetite in a marked degree; but abstinence is an imperative necessity if one is to obtain the full benefit of the waters.

The length of time required for a course of mineral water is not definite—varying according to the malady and the peculiarity of the water. From three to four weeks may, however, be named as an average.]

THE PHARMACOPŒIA

[Most countries are provided with a Pharmacopœia issued by authority from the government, or by some representative body, and, from time to time, revised. In others it is customary to accept, as authority, the Pharmacopœia of some other country, or some work of like nature. In the United States a convention is held decennially in Washington, composed of delegates from incorporated medical and pharmaceutical societies and colleges, and a committee is chosen who, during the interval preceding the next convention, revise and publish the work. The last convention was held in 1890, and the committee then chosen published the seventh edition of the "Pharmacopœia of the United States of America," in 1893. It is a work of over 600 pages, and relates exclusively to the description of drugs and articles employed as medicines; to the tests for their strength and purity; to processes to be used in their manufacture; the titles by which they are to be designated, etc.

In most of the States, laws regulating the sale of drugs and medicines specify the pharmacopœial standards of strength and purity as being the ones required by the laws, and in such States the obligation of a pharmacist to follow the directions of the Pharmacopœia is, necessarily, something more than a mere compliance with custom. Whatever his reasons may be for modifying a formula or changing a percentage of strength of an ingredient, he does so with legal risks.

It follows that it would be impracticable to consider in a Pharmacopœia things which are manufactured and sold as proprietary articles, or which have titles protected by copyright or by laws governing trade-marks, however good these articles may be, since no Committee of Revision can dictate to their owner what they shall be made of; how they shall be made; what their strength shall be, or what they shall be called. No restriction whatever is, or can be, placed upon the use of such unofficial articles by physicians; but it should be understood that, in the case of official (or pharmacopœial) substances, there are guarantees of strength, purity, and uniformity which, in the nature of things, cannot be with articles of a purely proprietary character.

Owing to the nature of the information contained in the

Pharmacopœia, it has come about, in this country, that several voluminous commentaries—mostly known as Dispensatories—have been privately issued. "The United States Dispensatory," "National Dispensatory," and the "American Dispensatory" are the most prominent and generally-used of these works; and, owing to their greater detail and, especially, to the information they contain regarding the uses of the substances described, and also to the fact that their contents is not restricted to such things as are strictly official, they have come to be better known among physicians than the Pharmacopœia, upon which they are founded. By many they are regarded as *the* authoritative works, because their relation to the Pharmacopœia is unknown or misunderstood.]

MODES OF ADMINISTERING MEDICINES

The method of administering medicines is a subject of practical importance. There are several modes and channels by which they may be introduced into the system, of which the following are the most important:

By the Mouth.—This is the first and simplest way, and the remedy may be given:

By itself.—As, for example, when we give cod-liver oil, or castor-oil, or extract of malt, alone and unmixed with any other substance.

In Water.—Many medicines are added to water before being taken, because they are too pungent to swallow alone or, as in the case of salts or alkaloids, when they cannot well be swallowed unless in solution. We have examples of the former among the ammonia preparations.

In Milk.—We give medicines in milk when it covers their taste, and especially when they are precipitated on being mixed with water. The ammoniated tincture of guaiacum is best given thus.

In a Mixture.—This is the favorite method when several articles are given together. In addition to the active ingredients there is often something added to impart to the mixture an agreeable taste. Mixtures are usually made up with water to such quantity as will make the dose measurable with a spoon. It is hardly necessary to give examples of mixtures, but the brown-mixture, the rhubarb and soda-mixture, and the compound iron-mixture of the Pharmacopœia, may be mentioned.

As a Natural Water.—These are in reality mixtures [or solutions], but compounded by nature, and not by the chemist.

Some drugs cannot be given in the liquid form because they are insoluble in fluids. In other cases, as when a patient is travelling, it is more convenient to have the medicine in a solid form. Solid medicines may be given as—

Pills.—These vary much in size. The old-fashioned chemist delighted in a large five-grain pill, but a pilule is preferable to a bolus, and the smaller they are the better.[1] Pills are usually round, but many people prefer them ovoid. The old-fashioned pill was usually sent out in a box containing lycopodium powder, to prevent them from sticking together; but pills are now usually coated. The oldest form of coating is silvering, the pills being shaken up in a box with silver-leaf. The gilded pill is a variety of this, gold-leaf being used, more especially in the case of dinner-pills. Sugar-coated pills are made in the same way as the sugar-coated almonds of the confectioner, the pills being placed in a hot, copper receptacle, with powdered sugar [or syrup and powdered starch], and quickly rotated. In France, sugar-coated pills are called *dragées* and, when very small, *granules*. French chalk is sometimes used, but it is not a good coating, and many pills, so coated, may be boiled in water for half an hour without dissolving their covering. Gelatin-coated pills are covered by being stuck on the end of pins and dipped into the [warm] solution. Lead-and-opium pills should not be treated in this way, as the gelatin becomes converted into a leathery mass which nothing will dissolve. Probably the best of coatings is a simple transparent varnish [of Tolu or egg-albumen]. Pills [made with some excipients] which have been long kept become hard and insoluble, and fail to exert any action, being expelled with the motions, unchanged.

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[1] [With this exception: A bolus is less apt to trouble persons whose pharyngeal muscles are unable to grasp a small pill, and who, therefore, experience a tickling of the pharynx by the adhesion of the small pill to the moist, mucous surface.]

Powders.—Some medicines are commonly given as a powder, but it is not a popular form of administration. A patient who is insensible, will often swallow a powder placed on the back of the tongue, when it would be almost impossible to get him to take a pill. Children are sometimes given powders in jam, but it is not a good form of administration [as it is liable to cause distaste for a wholesome and otherwise desirable article of food]. The best way to give a powder is to enclose it in a capsule, or in *cachets* made of flour and water.

It is a circumstance worth noticing that remedies administered in the form of powder, often produce effects quite different from, or even entirely opposed to, their ordinary action. This arises from the lodgment of fine particles of the powder in the mucous membrane of the stomach or intestines, where they act as irritants. It is well-known that many fruits act as purgatives or laxatives, from the stimulus afforded to peristaltic action of the intestine by the little seeds which they contain, and we have a closely analogous condition in the case of powders. Tannin, for example, usually acts as an astringent, and is given in cases of diarrhœa; but, if administered in the form of a capsule, so that the minute particles are set free in contact with the mucous membrane of the alimentary tract, it may produce vomiting or diarrhœa.

Triturations.—What are called "triturations" are largely employed in the United States, where a general formula for their preparation is official in the Pharmacopœia. They are prepared by rubbing together, so as to form an intimate admixture, ten parts (by weight) of the drug and ninety parts of sugar of milk, in moderately fine powders. There is no doubt that many insoluble drugs are rendered much more active by this minute subdivision; probably because they are brought into a condition in which they can be readily absorbed. These triturations are commonly put up in the form of tablets [formed in moulds, without compression (alcohol and, sometimes, a little mucilage being used to render them cohesive) and known as "tablet-triturates"] or tabloids, prepared by compression. Among the most popular of the tablet-triturates are those containing the equivalent of a minim of tincture of aconite in each; the one hundredth of a grain of corrosive chloride of mercury; the third of a grain of gray powder; a tenth of a grain of sulphide of calcium, and those containing minim doses of tincture of nux vomica, or tincture of belladonna. As the dose is small they must be given frequently to obtain their full effects, but there is no doubt as to their therapeutical activity.

Compressed Tablets [or "tabloids," as they are called in Great Britain, where, by the way, the title is protected by law as a trade-mark] afford a convenient mode of giving many drugs. The dose is accurately graduated, so that all trouble of weighing or measuring is avoided. Such as are intended for local application to the throat and adjacent parts, should be sucked; they have all the advantages of a continuous gargle. Those which are intended to produce a constitutional effect, should be swallowed whole. When they contain nauseous substances, they may be coated or varnished. They have many advantages over pills, and are largely prescribed. [There is reasonable doubt regarding the ready solubility of some varieties; and while, in such cases, they may be convenient as regards dosage and handling, it is well to powder them or dissolve them in water before they are taken.]

Capsules.—Many drugs are conveniently given in gelatin capsules, of which there are two kinds—empty, and filled.

The empty capsules are made in various sizes, and are furnished with a little cap which can be taken off to admit of the capsule being filled, after which the cover is replaced. Ready-filled capsules are frequently ovoid in shape [and are usually softer than empty ones, owing to a variable percentage of glycerin]. They are convenient for the administration of volatile or nauseous drugs, such as cubebs, copaiba, creasote, eucalyptol, etc. Large, flexible capsules are sometimes met with, and the argument usually employed is that they are smaller than an oyster and just as easy to swallow. A variety of capsule is the palatinoid, a gelatin envelope, which is sometimes divided by a septum to form what is called a bipalatinoid. These are, of course, coined words [and protected by trade-mark laws].

Lozenges or troches are commonly made with sugar, acacia, or tragacanth as a vehicle. They are hard and sometimes angular, and often irritate an inflamed or congested throat. A better plan is to make them with a fruit-paste basis, either black or red-currant being adapted for the purpose.

The custom of stamping a lozenge with letters indicating its composition, is a good one. "MA" means muriate of ammonium; "BA," benzoic acid; "CB," cubebs; "P," chlorate of potash; "T," tannin, and so on. At one time effervescent lozenges were employed; but they seem to have dropped out of use, although they are still sometimes used for the extemporaneous preparation of lithia and Vichy waters [the compressed tablet being, however, better suited to this use, has largely taken the place of lozenges or troches]. Pastils, another name for this form of remedy, are sometimes made with glycogelatin, which is a mixture of gelatin and glycerin, flavored with orange flower water and colored with carmine.

A *confection* or *electuary* is a convenient form of administration when the medicine is not readily soluble and has to be given in large doses. We have familiar examples in the confections of sulphur and senna.

By the Stomach.—Occasionally it is found necessary to introduce medicines directly into the stomach. A patient may have taken a narcotic poison, so that he is unable to swallow, and, in such a case, the stomach is usually washed out and the antidote given by means of the stomach-pump or, better still, by a stomach-tube used as a siphon. In a case of obstruction of the œsophagus—say from malignant disease—the patient may have to be fed with the stomach-tube, or, possibly, an incision may have to be made through the abdominal wall and the stomach itself be laid open.

By the Rectum.—This mode is frequently resorted to. If the bowel refuses to act, it is better to give a simple enema of a pint or a pint and a half of soap and water than to wait for the slower action induced by a purgative pill. Again, if a child suffers from thread worms, an injection of salt and water, or of infusion of quassia, or of a teaspoonful of tincture of perchloride of iron in a pint of cold water, will soon get rid of them. In cases of obstinate diarrhœa, a small injection of starch-water and opium speedily affords relief. Nutritive enemata are almost universally resorted to in cases of gastric ulcer, to rest the affected viscus. They usually consist of beef-tea and brandy, with, perhaps, a few drops of laudanum.[1] In many cases it is found advantageous to predigest the food with pancreatin. Nutritive enemata must be small, and should not exceed three or four ounces, or they will not be retained. Every few days the bowel should be washed out with a pint or more of tepid water, or the rectum will become irritable.[2] I have kept a patient alive for fifty-six days by rectal feeding alone.

Suppositories of all kinds are used for introducing drugs into the rectum, and opium may thus be given to induce sleep after severe operations. When nutritive injections are not retained, suppositories containing peptones may be resorted to with advantage.

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[1] [Administration of alcoholic stimulants in this way sometimes causes such irritation of the rectum as to be impracticable.]

[2] [Water alone occasionally irritates the rectum and needs the addition of enough table-salt to give to it the same specific gravity as that of blood-serum—*i.e.*, about a drachm to a pint of water.]

By the Skin.—Remedies may be introduced into the circulation through the skin:

Hypodermically.—Who originated this mode is not quite clear, but probably the credit is due to Dr. H. Augustus Wilson, of Philadelphia, the author of a paper published in 1881, entitled "Soluble Compressed Pellets: a New Form of Remedies for Hypodermic Use, and applicable to Ophthalmic and General Medication."[1]

There are many advantages in giving medicines hypodermically: a small dose will suffice, the stomach is not deranged, and the action is more prompt. In the majority of cases the needle of the hypodermic syringe is introduced just under the skin. Ergotin, however, produces a good deal of irritation, and it is best to push the needle in deeply so as to make the injection into a muscle.

It is not safe to employ hypodermic solutions unless they are freshly prepared. If they are kept any considerable time they undergo decomposition and a fungus forms, so that when injected under the skin they give rise to a good deal of irritation. Most people prepare the solution as required by dissolving a tablet in water.

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[1] [This related to the use of soluble pellets or tablets for extemporaneous preparation of solutions, and not to the hypodermic mode of administration. Dr. Alexander Wood, of Edinburgh, who described this method in 1855, commenced its use in 1844. The late Prof. Isaac E. Taylor, of New York, assisted by Dr. James A. Washington, in a dispensary service in 1839, inserted the nozzle of an Anel's syringe through an incision of the skin, and injected remedies into subcutaneous cellular tissue. One year prior to this, Dr. Rolland ("St. George's Hospital Reports," 1849) inserted a sixteenth of a grain of morphine, in the form of a paste, into punctures in the shoulder of a neuralgic patient. Mr. Charles Hunter, of London, introduced the use of a sharp-pointed nozzle, and practically developed the essential features of the instrument. The first use of the hypodermic syringe proper, in this country, was in May, 1856, by the late Prof. Fordyce Barker, of New York, who received it from Sir James Y. Simpson while visiting the latter in Edinburgh shortly before.]

[It should hardly be necessary to add that the needle and syringe must be absolutely clean; but, unfortunately for patients, a dirty needle (perhaps with a blunt point), and a piston green with verdigris, are much too common, and are blamable for most of the so-called "hypodermic abscesses." As it is the growth of the fungus in an alkaloidal solution which causes chemical decomposition, it follows that the solution, instrument, and skin should be aseptic. When a solution is to be kept for some time, chloroform-water (two minims to an ounce of distilled water) will be the best solvent, as it is found to prevent the growth of fungus and does not produce disturbance when injected. The following simple contrivance, by a former *interne* of the New York Hospital, is not sufficiently known: An india-rubber nipple for a nursing bottle, having no perforations in its tip, is slipped over the mouth of the vial holding the solution. The needle of the syringe is pushed through the rubber, the vial is inverted, and the piston of the syringe is withdrawn until the amount of solution wanted has been drawn by the piston into the barrel of the syringe. Upon the extraction of the needle the puncture is closed by the elasticity of the india-rubber, and no air can enter the vial.]

Among the remedies most commonly used hypodermically are the following-named:

Morphine, to allay pain, relieve spasm, and induce sleep.

Apomorphine, as an emetic.

Atropine, to check sweating and, in combination with morphine, to allay pain.

Pilocarpine, to produce sweating.

Strychnine, to restore power to paralyzed muscles.

Ergotin, to induce uterine contraction.

Aconitine, in the treatment of neuralgia.

Curarine, to paralyze motor nerves in the treatment of tetanus.

Ether and Brandy, as stimulants in collapse.

Many others could be included in such a list if space permitted, notably the toxins so recently introduced.

Inunction is another way of introducing drugs into the system through the skin.

Mercurial ointment is rubbed into the armpits and other parts of the body in the treatment of syphilis, and the oleate of mercury is also largely employed for the same purpose.

Oil is thus used sometimes in the case of consumptives who cannot take fat in the ordinary way, and this mode of treatment is especially adapted for children [the flexures of large joints and the epigastrium, owing to the greater abundance of lymph-channels in these regions, being the preferable locations for this form of treatment]. That the inunction of castor-oil will act as a purgative is well known.

Liniments rubbed into the skin not uncommonly induce the constitutional effects of their ingredients, and the same may be said of plasters. A good belladonna plaster will dilate the pupils and produce a rash all over the body.

Remedies are readily absorbed from the surface of hot, moist poultices. If a linseed-meal poultice is ordered for a baby it is not safe to sprinkle it with laudanum, or enough may be absorbed to induce narcotic poisoning.

Before the introduction of the hypodermic method it was customary to raise a blister and dust the powdered medicine over the raw surface—[known as the endermic method].

Transfusion.—Remedies are introduced directly into the circulation through an incision in a vein. Saline solutions are injected in this way in the collapse of cholera. The value of transfusion of blood from arm to arm in cases of post-partum hæmorrhage is well known, but it is probable that the transfusion of a saline fluid would prove equally efficacious. In cases of poisoning, the injection of saline fluids is useful by reducing the percentage of poison in the blood. The following is the best formula :

Chloride of Sodium,	ʒ j.
Bicarbonate of Sodium,	gr. iv
Chloride of Calcium,	gr. j.
Water,	℥ xx.

When the requisite materials are not at hand for making an intravenous injection, this fluid may be introduced into the peritoneal cavity, from which it is absorbed. No apparatus is needed beyond a piece of india-rubber tubing with a cannula at one end and a funnel at the other. The tube should be rendered aseptic by washing it out with a boric acid solution, the solution to be injected being boiled for a few minutes and then allowed to cool down to 100° F. Further details of this method of treatment will be found in a subsequent article.

Inhalations are commonly employed for their local effect on the throat and chest; but they are often useful in producing the constitutional effects of a remedy. There are many different kinds, both moist and dry. A familiar example of a moist inhalation is afforded by putting a teaspoonful of Friar's balsam in a pint of water, at 135° F., and inhaling the steam. Ten drops of tincture of iodine added to water in the same way, will produce an iodine vapor which is useful in phthisis and chronic bronchitis. [When the soothing effect of warm vapor, as well as that of a remedy like the lupulin of hops, is desired—as in catarrhal inflammation of air-passages—at least a quart of hot water and a covering for the pitcher (like a blanket) should be used, and a considerable space be left for the accumulation of an abundance of the vapor.] Sometimes air is inspired through a tube containing a little plug of cotton-wool moistened with oil of eucalyptus, terebene, or pinol, and this affords a good example of a dry inhalation. The common menthol-inhalers, used for relieving cold in the head, come under this category.

[For their constitutional effects, inhalation is resorted to with volatile stimulants; with chloroform, sulphuric ether, nitrous oxide, etc., as anæsthetics, and with amyl nitrite, for relaxing the muscular coat of blood-vessels and bronchial tubes.]

The following inhalations are commonly prescribed for use with a steam spray-apparatus:

Alum—15 grains to an ounce of water, in chronic catarrhal affections of the pharynx, and in chronic bronchial affections attended with much secretion.

Tannic Acid—10 grains to the ounce of water, in laryngeal ulceration, and in slight hæmorrhage from the mouth or throat.

Tincture of Chloride of Iron—15 minims to the ounce, in chronic pharyngitis and laryngitis.

Ipecacuanha Wine—equal parts of the wine and of warm water, in chronic bronchitis and emphysema, but not in asthma.

Sulphate of Zinc—4 grains to the ounce, in bronchial catarrh with excessive secretion.

Chlorate of Potassium—a saturated solution in water, in catarrhal laryngitis and chronic bronchitis.

Iodine—15 minims of the solution in an ounce of water, in cases of fœtid secretion from the lungs.

Conium—half a drachm of the succus, with 20 minims of solution of potash to an ounce of water, in the irritative cough of phthisis.

Arsenic—5 minims of solution of arsenite of potassium to the ounce of water, in cases of chronic consumption.

Turpentine—2 minims to the ounce of water, in cases of gangrene of the lung, and fœtid secretion from the bronchial tubes.

Other substances, such as eucalyptus, terebene, and pinol, are often used as inhalations, either alone or mixed.

For use in an atomizer, one of the liquid petrolates, specially prepared for this purpose, will sometimes be found convenient as a basis. Various combinations of terebene, pinol, oil of cubebs, and oil of sandal-wood, diluted with the liquid petrolate, may be employed. The following are good formulas:

1.	Terebene,		
	Oil of Cubebs,		
	Oil of Sandal-wood,		āā ʒ i.
	Liquid Petrolatum,	to	℥ j.
2.	Iodoform,		gr. xx.
	Creasote,		♏x.
	Oil of Eucalyptus,		♏xx.
	Ether,		ʒ j.
	Expressed Oil of Almond,	to	℥ j.
3.	Tincture of Iodine,		ʒ j.
	Glycerin,		℥ j.
	Alcohol,	to	℥ iij.
4.	Compound Tincture of Benzoin,		fl. ℥ j.
	Glycerin,		fl. ℥ j.
	Alcohol,	to	℥ iij.

Fumes of chloride of ammonium are often inhaled, the apparatus usually consisting of two bottles, one containing ammonia and the other hydrochloric acid. The vapors mix, and are then washed by being drawn through water in a wash-bottle to which, if thought desirable, oil of eucalyptus or a similar substance may be added.

As an example of a remedy used in the form of vapor to induce a constitutional effect, may be mentioned inhalation of calomel in the treatment of syphilis [and membranous croup].

Many drugs are smoked, not merely as a luxury, but with the view of inducing some definite therapeutical effect. The following is a list of some drugs which are most commonly smoked :

Tobacco, for its sedative effect.

Indian Hemp, as a luxury, and for the mental excitement it produces.

Opium, to allay cough in phthisis, and in many painful affections.

Lobelia, as an anti-spasmodic, especially in asthma.

Cubebs, as an expectorant in chronic bronchitis, and in hay-fever, coryza, etc.

Arsenic, for its constitutional effect in cases of phthisis.

Stramonium, in cases of asthma to relieve dyspnœa.

Some of these drugs are commonly smoked in a pipe, others more conveniently in the form of a cigarette. The opium-pipe is quite different in shape from the one used for tobacco-smoking, the bowl being near the middle of the stem.

Dr. Reginald Thompson advocates the use of various kinds of cigarettes, not only for allaying the irritative cough of early stages of consumption, but for relief of the dyspnœa of asthma and bronchitis. These cigarettes are made by dipping sheets of thin Swedish filter-paper in preparations of the drugs. The following is one of Dr. Thompson's formulas, the quantity sufficing to make sixty-four cigarettes :

Tincture of Tobacco,	ʒ x.
Tincture of Conium,	ʒ ij.
Tincture of Lobelia,	ʒ ij.
Tincture of Cannabis Indica,	♏ xxxij.
Extract of Opium,	gr. j.
Extract of Stramonium,	gr. ij.
Oil of Anise,	♏ viij.
Nitrate of Potassium,	gr. xvj.
Alcohol,	to ℥ ijss.

This formula (which, it must be admitted, is somewhat complicated) was arrived at, we are told, by repeated experiments leading, step by step, to the addition of some effective remedy and to elimination of the less effectual.

Fuming inhalations which give off abundant smoke are used in the treatment of asthma and in sleeplessness, and usually take the form of nitre-paper, made from blotting-paper—the white is the best. Squares of any convenient size—say six by six inches—are dipped into a hot, saturated solution of nitrate of potassium, and allowed to dry either in the sun or in front of a fire. Their composition can be altered in various ways. For example, the solution may contain, in addition to the nitre, chlorate of potassium with or without iodide of potassium, and the papers, when dry, may be sprinkled over with Friar's balsam, spirit of camphor, or tincture of sumbul. Some people recommend that a small piece of the paper should be burnt in a tumbler and the fumes inhaled; but a better plan is to set fire to a large piece in a coal-scuttle, or on a fire-shovel, and fill the room with smoke.

Inhalation of oxygen from a cylinder of compressed gas is useful in pneumonia, phthisis, chronic bronchitis [and in such affections as diminish the quantity of air inspired, so that it becomes desirable to increase the percentage of oxygen], and, possibly, in certain gouty conditions.

[In using oxygen in this way it is customary, here, to pass it through a wash-bottle partly filled with water. The tube by which the gas enters the bottle has several side-openings at various distances below the surface of the water, and the flow of gas is regulated so that it escapes only through the upper holes. When the flow is too rapid the pressure forces the water lower in the tube, and gas escapes from the lower holes and at the end. This is wasteful and causes discomfort to most patients.]

Compressed air and other gases are, from time to time, used in special cases [and one of the few means that are capable of alleviating the discomforts which attend pulmonary emphysema, is the respiration of rarefied air].

These, then, are the principal channels and methods by which medicines may be introduced to the system. There are others, but they are of less importance, and are usually employed for the production of a local effect. Drops for the eye—atropine or homatropine—might produce a constitutional effect. Urethral injections are familiar to every one, and urethral bougies are also in use. Bougies of iodoform, belladonna, and sulphate of zinc are used in coryza, nasal polypus, and allied affections. Morphine suppositories are introduced into the vagina after labor, and perchloride of iron is sometimes injected into the uterus to arrest hæmorrhage; but these are not ordinary methods for the administration of medicines. Substances are sometimes applied locally, in the form of gases or vapors. For example, a few drops of chloroform placed on the hand and held in front of the eye, will give relief in cases of photophobia. Dr. George Stoker's treatment of ulcers by the local application of oxygen gas may also be mentioned.

PRINCIPLES OF DOSAGE

It is clear that as drugs differ much in their activity, some medicines must be given in smaller doses than others. No one requiring a purgative would think of taking the same dose of calomel as he would of Epsom salt. Many drugs which act beneficially in small doses, would in large doses prove poisonous. There is no real difference between a medicine and a poison, for a drug, which is an active poison in a large dose, nearly always acts beneficially in small doses.

When we speak of the dose of a medicine, we mean that quantity which will produce its therapeutical action, either at once or after a series of repetitions. By the maximum or minimum dose we mean the quantity, as regards limit of range, which it is safe to give to an average adult. Most medical men depart widely, as occasion arises, from the doses given in posological tables. No one, for example, would care to accept ten grains as the maximum dose for sulphate of quinine, nor would we feel inclined to limit ourselves to twenty grains as the maximum dose of iodide of potassium, while, on the other hand, most of us regard fifteen minims as an extremely large dose for tincture of aconite, and hesitate, considering the uncertainty regarding the strength of different commercial samples of dilute hydrocyanic acid, to prescribe it in eight minim doses.

It is important to remember the doses of those things which are given in only small quantities, and it must always be borne in mind that children require smaller doses than adults; that, moreover, children are especially susceptible to the action of some drugs. Opium, and all of the narcotic class, should be given with very great caution to children; on the other hand, they take all preparations of mercury well. Belladonna, too, is well-borne by children, and in cases of whooping-cough, and incontinence of urine, it is by no means uncommon to prescribe, for a child four years old, ten minims of tincture of belladonna every four hours. Pilocarpine, which so readily induces perspiration and salivation in adults, has very little effect on children.

It is difficult to lay down absolute directions for determining the relative doses to be given at different ages. As a rule the amount should be increased from birth to the prime of life; it reaches the maximum about fifty, and then gradually declines as age advances. The following tables will, however, be of some assistance:

Taking the dose for an adult as unity, a patient

Under	1 year	requires	$\frac{1}{15}$ to $\frac{1}{12}$	of this dose.
"	2 years	"	$\frac{1}{8}$	"
"	3 "	"	$\frac{1}{6}$	"
"	4 "	"	$\frac{1}{4}$	"
"	7 "	"	$\frac{1}{3}$	"
"	14 "	"	$\frac{1}{2}$	"
"	20 "	"	$\frac{2}{3}$	"
From	20 to 50	"	1 = the full dose.	

It is not worth the effort to remember these figures, for there is a very simple rule by which the proportion may be found with sufficient exactness for all practical purposes: For children under twelve, the adult doses of most medicines must be administered in the proportion of the age to the age increased by twelve; or, in other words, divide the child's age by the same number plus twelve, and the required proportion will be obtained. For example:

The proportionate dose for a child four years old would be:

$$\frac{\text{Child's age}}{\text{Add 12 to child's age}} = \frac{4}{16} = \tfrac{1}{4} \text{ of the full dose.}$$

[Dr. R. O. Cowling, of Louisville, suggested, as another rule, to divide the number of the following birthday by 24 —*i.e.:*

At 2 years $\frac{3}{24} = \frac{1}{8}$.]

The most accurate method of determining dosage is to weigh the patient and to give so much per pound, but in actual practice this is not convenient. The method, however, is always resorted to in pharmacological investigations. For example, the minimum lethal dose of strophanthin is, for frogs, about 0.0005 grain, or $\frac{1}{200000}$ of a grain per 100 grains-weight of frog, and for rabbits about 0.003 grain, or $\frac{1}{333}$ grain per pound-weight of rabbit.

As regards the best time for administering medicines :

Bismuth is given before meals, being commonly employed for its local, sedative action on the mucous membrane of the stomach.

Bicarbonate of sodium, when given to increase the secretion of gastric juice, is given before meals.

Pepsin is given after meals, as it helps digestion.

Cod-liver oil is given after meals, as it is then most readily absorbed, and, being of the nature of a food, would spoil the appetite if given before meals.

Permanganate of potassium is always given after meals, for if given on an empty stomach it would irritate the mucous membrane, and possibly produce ulceration.

Iron is usually given after meals, especially when an astringent preparation is employed.

Arsenic is given after meals, but if only small doses are administered, better effects are produced by giving it before meals.

Hypodermic injections of morphine should always be given when the patient is actually in bed.

Pilocarpine, administered to produce sweating, should be given when the patient is in bed in a warm room.

Acetate of ammonium acts as a diaphoretic when the patient is warm in bed, but as a diuretic when the patient is in a cold room.

Sulphonal should be given two or three hours before the patient wishes to sleep, as it dissolves slowly.

PALATABLE MEDICINES

The importance of giving medicines in a palatable form cannot be over-estimated. It is useless to prescribe the right remedy if it is so nauseous that the patient cannot be induced to swallow it. There has been some improvement in this respect of late years, and it must be admitted that American chemists have, in many instances, given their European brethren a useful lesson. In pills, for example, the improvement has been very marked. A few years ago a pill was always five grains, however small the dose of the active ingredients might be. The modern chemist aims at making his pills as small as possible, and the pilule has to a great extent replaced the bolus. Pills, too, are now commonly varnished, and are sent out in dainty little bottles, and not in pill-boxes reeking of lycopodium powder or other abominations. Introduction of the tablet has done much to facilitate the administration of medicines, and both doctors and chemists are keenly alive to the necessity for giving medicines in a palatable form.

The British Pharmacopœia is lamentably deficient in flavoring agents. There are a few syrups, such as those of orange-peel, orange-flower, lemon, and of Tolu; there are one or two infusions, such as the infusion and the compound infusion of orange peel, and that is about all. Spirit of chloroform, it is true, is a useful adjunct to many mixtures; but patients are frightened when they see the word "chloroform" in a prescription, and raise all kinds of absurd objections, necessitating explanations which they neither understand nor appreciate; whilst the synonym "chloric ether" is equally liable to arouse their suspicions. The fluid-extract of liquorice is useful in covering the salty and pungent taste of chloride of ammonium, but it can hardly be said to be a palatable preparation. [Both liquorice and yerba santa (*Eriodictyon glutinosum*), in form of fluid-extract, elixir, or syrup, cover the bitterness of quinine; but in the use of the former, especially, the mixture should be made only just before the dose is taken, since, after a time, the quinine becomes dissolved in the vehicle and the particles of quinine are no longer coated by glycyrrhizin.]

Other pharmacopœias are much better off in this respect than the British. The French *Codex*, for example, simply teems with flavoring agents. Looking down the list it is seen that there are considerably over a hundred syrups alone; many of these, it is true, are complex in composition: *Sirop d'Armoise Composé* boasts of no fewer than eighteen constituents, and others contain active ingredients; but the great majority are simple, palatable preparations, useful as vehicles for the administration of nauseous substances.

In the United States elixirs of all kinds are largely prescribed. They are aromatic, sweetened, spirituous preparations, admirably adapted for flavoring purposes. What is known as the simple elixir may be prepared according to no less than eight different formulas, so that the choice is ample. The chief ingredients are fresh orange peel, alcohol, syrup, and water; but oil of cinnamon, coriander, star-anise, nutmeg, caraway, cassia, canella, and a number of other aromatic bodies, are frequently added. Simple elixir is colorless, but to produce various tints small quantities of cochineal, cudbear, or carmine are useful.

[By authority of the American Pharmaceutical Association, a "National Formulary of Unofficinal Preparations" has some time been in use for many compounds more or less demanded. In it are, among others, formulas for:

Elixir Adjuvans (Adjuvant Elixir)—Chiefly intended as a vehicle, particularly for acrid or saline remedies.

Elixir Aromaticum (Aromatic Elixir)—Also useful as a vehicle.

Elixir Cinchonæ (Elixir of Calisaya).

Elixir Cinchonæ Detannatum (Detannated Elixir of Calisaya)—Preferable when used in combination with preparations of iron.

Elixir Eriodictyi Aromaticum (Aromatic Elixir of Yerba Santa, or Elixir Corrigens)—A vehicle for quinine and other bitter remedies.

Elixir Taraxaci Compositum (Compound Elixir of Taraxacum)—A vehicle or corrigent to cover the bitter taste of quinine and similar substances.

Syrupus Coffeæ (Syrup of Coffee).

Syrupus Eriodictyi Aromaticum (Aromatic Syrup of Yerba Santa)—Used in place of the elixir above mentioned, when an alcoholic ingredient is not desirable.

Many of the fruit-syrups commonly used for flavoring carbonic acid water are also available in prescription work.]

ART OF PRESCRIBING

Very few students know how to prescribe, and yet there is very little difficulty about it. The principal thing necessary is to know a few doses. Let us take a simple prescription and see what we can make of it: A patient has a hacking cough, unaccompanied by expectoration, for which we want to prescribe small doses of morphine, to be taken frequently, in the form of a syrup. The ordinary dose of the liquor morphinæ acetatis, or liquor morphinæ hydrochloratis[1] (for it is a matter of indifference which we prescribe), is fifteen minims; but if we give three minims at a dose, it will be sufficient to check cough without disturbing the stomach or producing constipation. If it is to be taken frequently, the actual quantity of fluid prescribed should not be large, and it should be more or less sticky or mucilaginous, so that it will hang about the back of the throat. The following prescription answers the purpose admirably:

[1] [Solutions official in Great Britain and containing about four and a half grains in each ounce.]

Solution of Hydrochlorate of Morphine,[1]	♏iij.
Spirit of Chloroform,	♏iij.
Syrup of Lemon,	ʒ ss.
Water,	ad ʒ j.

If we want to give this in a four-ounce bottle with teaspoonful doses, it is simply a matter of multiplying by the number of drachms in four ounces—that is, by thirty two—or, for the sake of convenience, let us say thirty, when the prescription will assume this form:

Solution of Hydrochlorate of Morphine,[1]	
Spirit of Chloroform,	āā ʒ iss.
Syrup of Lemon,	℥ ij.
Water,	ad ℥ iv.

A teaspoonful occasionally.

To make a change in the taste of the medicine we substitute for the syrup of lemon simple glycerin, syrup of Tolu, or a somewhat smaller quantity of syrup of wild-cherry; and we may, if so inclined, dilute any of these with mucilage of acacia. If, in addition, we want to give an expectorant, we add five minims of wine of ipecacuanha to each dose. Thus we have at least half a dozen prescriptions ready for use, and all formed on the same model.

Now take the ordinary gentian and sodium-mixture, commonly used in the treatment of dyspepsia, which runs as follows:

Bicarbonate of Sodium,	gr. xv.
Spirit of Chloroform,	♏xv.
Compound Infusion of Gentian, to	℥ j.

If we wish to make this stronger, we put in half a drachm of compound tincture of gentian, and if we wish it more palatable we add half a drachm of tincture of orange-peel, or syrup of orange. If we wish for a sedative action on the stomach, three minims of dilute hydrocyanic acid will not be amiss; and if we desire a carminative action there is no objection to ten minims of tincture of ginger. To obtain a tonic effect, some of the other ingredients may be replaced by ten minims of tincture of nux vomica. This mixture, being alkaline, is usually given a quarter of an hour before meals, to increase secretion of gastric juice; but if we prefer giving a medicine after meals, all we have to do is to substitute for the bicarbonate of sodium fifteen minims of dilute hydrochloric acid. When we are tired of the infusion of gentian we replace it by tincture and infusion of quassia or calumba, so that we have an entirely new series of prescriptions. It is a very simple matter, and, from a basis of a single formula, we find ourselves in possession of a couple of dozen prescriptions.

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[1] [The British Pharmacopœia solution, not official in the United States, is of 1 per cent strength.]

The ordinary tonic quinine-mixture is capable of being manipulated in a very similar way. The usual formula is:

Sulphate of Quinine,	gr. xvj.
Dilute Sulphuric Acid,	ʒ ss.
Water,	to ℥ viij.

Two tablespoonfuls three times a day, before meals.

The taste of this mixture can be altered by substituting cinnamon water for ordinary water, or by adding ten minims of tincture of orange-peel and half a drachm of simple syrup to each dose. The addition of a couple of grains of sulphate of iron to each dose converts it into a mixture of iron and quinine.

The ordinary chloride of iron mixture presents no difficulty:

Tincture of Chloride of Iron,	
Spirit of Chloroform,	
Glycerin,	āā ♏xv.
Water,	ad ℥ j.

If it is thought desirable to give digitalis, it is only necessary to add a couple of drachms of the freshly-prepared infusion; but as this makes a black and unsightly mixture, the addition of fifteen drops of dilute phosphoric acid is an advantage.

The best pill for anæmia and chlorosis is the following:

Dried Sulphate of Iron, gr. v.
Simple Syrup, enough to make a pill.

These pills are quite hard, but, when thrown into water, rapidly disintegrate, the salt being deposited in a form in which it is rapidly absorbed by the stomach. These pills should never be made with vegetable extracts, or they will form a sticky mass which is but slowly soluble, and, not uncommonly, irritates that portion of the mucous membrane of the stomach with which they come in contact. Five grains of the dried sulphate of iron are equivalent to nine grains of the crystalline salt, and as most patients take without difficulty two pills three times a day, after meals, the amount of iron administered is considerable. The addition of one-hundredth of a grain of arsenious acid to each pill is often advantageous. These pills are apt to constipate, and, in cases of anæmia, little benefit is derived from iron unless the bowels are kept well open.

An excellent purgative pill is the following:

Calomel, gr. iij.
Extract of Hyoscyamus, enough to make a pill.

This pill, if taken at bedtime, usually acts well and comfortably, without causing inconvenience. The henbane prevents griping and straining. [When, however, there is daily need for a peristaltic persuader, calomel is not altogether desirable, since its constitutional effects may be developed.]

A student who commences professional life with half a dozen prescriptions like those above given will not do badly. At all events, he will not be in the position of the man who said that his difficulty was not so much in prescribing the right thing, as in prescribing anything at all.

The beginner, in what may be called the experimental stage of his prescribing life, should not attempt any wide range, but should limit himself to accurately observing and acquiring a knowledge of the value of

Small doses of tincture of aconite, frequently repeated, in the treatment of tonsillitis, and in the initial stage of febrile diseases.

Painting the chest and back with iodine liniment—diluted, if necessary, with an equal quantity of the tincture—in all cases attended with cough.

The dried sulphate of iron pill, conjoined with purgatives, in the treatment of anæmia.

Grain-doses of gray-powder, with an equal quantity of Dover's powder, three times a day, in the treatment of syphilis.

Large doses of the iodides, in the treatment of tertiary syphilis.

Large doses of bromide of potassium, in the treatment of the "heats and flushes," and other symptoms from which women suffer about the time of the menopause.

Quinine in the treatment of supraorbital neuralgia, and in the periodical febrile disturbance from which old malarial patients suffer.

Five grains of butyl-chloral-hydrate, with one two-hundredth of a grain of gelsemine, in neuralgia of the fifth nerve.

Small doses of a saturated solution of camphor in alcohol, in the treatment of autumnal or choleraic diarrhœa.

Small doses of bichloride of mercury, in the treatment of infantile diarrhœa, when the stools are green, slimy, and offensive.

Sulphurated lime, in doses of a tenth of a grain, in the treatment of boils, carbuncles, and abscesses.

Nitroglycerin and nitrite of amyl, in the treatment of angina pectoris and allied conditions.

Alcohol, in the treatment of fevers, and of

Flying-blisters, in typhoidal conditions.

PHARMACOLOGY

OF

INORGANIC SUBSTANCES

PHARMACOLOGY

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BROMINE AND BROMIDES

Bromine is a liquid, non-metallic element. It derives its name from βρωμος=a stench, a title conferred on it in honor of its disagreeable odor. It is a disinfectant, but is rarely employed for this purpose, the peculiarity to which reference has been made militating against its general acceptance in that capacity. It is sometimes inhaled in small quantities, but, being a powerful irritant, may excite bronchitis or pneumonia. It is a caustic, and has been used as a local application to the os uteri. Applied undiluted, it destroys organic tissues and forms a slough. In the United States during the last war it was somewhat used for this purpose in the treatment of hospital gangrene.

It is recommended for nasal catarrh, hay fever, paroxysmal sneezing, and diphtheria ; but it is not extensively employed. Half a drachm may be mixed with four ounces of alcohol in a wide-mouth bottle and vaporized by the heat of the hand.

[**The Bromides** which are recognized by the U. S. Pharmacopœia are those of ammonium, calcium, potassium, lithium, sodium, strontium, and zinc. They differ somewhat as regards their equivalent of bromine, and it has been suggested that the effect of the basic element is something to be considered in a choice of a bromide.]

ACTION.—In animals, the bromides give rise to a diminution of reflex irritability and cutaneous sensibility, due in part to the effect of the drug on the cord, and in part to its influence on the sensory nerves. They contract the blood-vessels, including those of the brain, inducing anæmia of that organ. The potassium compound is more depressing than the ammonium, the ammonium more than the sodium.

Applied topically, bromide of potassium impairs the contractibility of voluntary muscles, and destroys the function of motor nerves. It lessens the frequency and force of the heart's contractions, shortens the systole, and prolongs the diastole, finally arresting it in diastole. The action on the heart is probably due to the potassium of the salt and not to the bromine.

The bromides are absorbed by the stomach and pass quickly into the circulation. It is probable that they are partly eliminated by the mucous membrane of the stomach. This may be proved by a very simple experiment: Twenty grains of bromide of potassium are injected into the rectum, and, after a short interval, the stomach is washed out with a stomach-tube; on testing the fluid withdrawn from the stomach, it will be found to contain bromides. Recent researches of Kandidoff have shown that many drugs—such as iodide of potassium, hydrochlorate of quinine, salicylate of sodium, arsenic, and antipyrin—when introduced into the rectum, are discharged, at all events in part, by the mucous membrane of the stomach. They are eliminated with the urine, and traces may be detected within ten minutes of taking a dose; as excretion takes place slowly they may appear for some days after the drug has been discontinued. They may be detected in the milk, sweat, or saliva.

Certain effects are produced by the long-continued use of bromides, to which the term "bromism" is applied.

The symptoms constituting bromism are:

An eruption like acne, which may go on to the formation of boils or even small ulcers. It is seen chiefly on the face and back. The face at the same time presents a muddy or dusky hue. There is abolition of reflex action of the soft palate, evidenced by absence of movement when the back of the throat is irritated. Although reflex irritability is lessened, there is no true anæsthesia, the pain of an operation on the part being felt. The intellectual faculties are blunted; memory is impaired; ideas are confused; the patient is dull, stupid, and apathetic, and has a constant desire to sleep; speech is slow and impaired; the tongue is tremulous; the body is infirm; the limbs are feeble; the gait is staggering, and the movements are incoordinated. The sexual powers are impaired or even temporarily abolished. There is general cachexia.

These symptoms are, for the most part, due to impairment of the functions of the spinal cord and brain. They soon disappear when the administration of the drug is discontinued.

THERAPEUTICS.—There can be no doubt as to the efficacy of bromide of potassium in the treatment of many diseases, although it is worthy of note that it was omitted from the British Pharmacopœia in 1851, after having been introduced into the London Pharmacopœia in 1836.

It has been suggested, from the effect of the drug on the reflex action of the upper part of the pharynx, that its local application might be useful in laryngoscopic examinations; practically, however, it is rarely used for this purpose, a preferable plan being to give the patient ice to suck.

It is found to be of value in the treatment of whooping-cough, and here again it is said to act by lessening the irritability of the larynx. It is only in uncomplicated cases of whooping-cough that it does good; in cases complicated with bronchitis or teething, other remedies may be resorted to with expectation of greater benefit.

Many middle aged women experience difficulty in swallowing fluids, especially in public, the attempt to do so inducing an attack of choking. This condition is probably due to nervousness, and may be relieved by a systematic course of the bromides. A somewhat similar complaint is met with in children, and the same mode of treatment is indicated.

From the action of the drug on the cord its use is indicated in all kinds of convulsions. It is especially useful in epilepsy, in the convulsions of Bright's disease, in eclampsia, and in the convulsions of children, whether due to centric or eccentric causes. In epilepsy it is our sheet-anchor. There are few, if any, drugs which can be demonstrated to have a more beneficial action in the treatment of disease than that of the bromides in epilepsy. They do more good in the *grand mal* than in the *petit mal.*

Dr. Hughes Bennett made an inquiry into the action of the bromides in epilepsy, and arrived at the following conclusions: In twelve per cent. (omitting fractions) the attacks were completely arrested during the whole period of treatment; in eighty-three per cent. the attacks were greatly diminished, both in number and severity; in two per cent. the treatment had no apparent effect, and in two per cent. the number of attacks was augmented during the period of treatment. The bromides were equally efficacious whether the disease was inherited or acquired; whether complicated or not; whether recent or chronic; whether occurring in the young or in the old. The common practice in the treatment of epilepsy is to give the potassium salt alone; but better results are to be obtained by a combination of all three bromides.

One of the great difficulties in the prolonged administration of the bromides in epilepsy is that they produce acne of the face. Women naturally object to being made "spotty," even when they derive benefit in other ways. Relief from this symptom may sometimes be obtained by ringing the changes on the different salts; but in many patients they all produce a rash. The addition of half a drachm of aromatic spirit of ammonia to each dose of bromide of potassium is often recommended; but this is not always successful, as, probably, it simply converts the bromide of potassium into bromide of ammonium. The addition of a couple of drops of the liquor arsenicalis to each dose sometimes proves efficacious; but we have still to find a thoroughly satisfactory bromide for epileptics.

In the diseases incidental to teething, bromides may often be given with advantage.

The bromides are useful as soporifics in the sleeplessness of acute illnesses, or when due to worry, overwork, grief, or dyspepsia. They are commonly given in combination with other narcotics, often with belladonna and hyoscyamus.

In the restlessness from which business men frequently suffer, and the irritability often experienced by women as the result of over-attention to their household duties, the bromides are the best remedies. Women say that bromide of potassium is to them what tobacco is to men.

In the heats and flushes from which many women suffer about the time of the menopause, the bromides are of the greatest possible value. They also control the restlessness and excitability from which many women suffer during pregnancy. In dysmenorrhœa and menorrhagia the administration of bromides is attended with the best results.

In the treatment of hysteria the bromides will be found of the greatest value, and it is a good plan to give a mixure of the three—ammonium, potassium, and sodium bromides. The same mode of treatment is useful in megrim or sick-headache, and in some forms of neuralgia.

In the treatment of sea-sickness bromides are also of great value, but they must be given in large doses. The late Dr. George Beard, of New York, advocated the administration of a single dose of from 100 to 120 grains of the mixed bromides in a tumbler of water. He says: "In many cases large doses of bromides, say 100 to 120 grains, or even a larger amount, given in a tumbler of water, may be sufficient of itself, without any repetition in any quantity, to break up an attack of hysteria or sea-sickness, whereas the same case, in the same condition, treated by divided doses of the same remedy, might not be affected at all."

In night-screaming, nightmare, and somnambulism, the bromides yield excellent results.

In delirium tremens full doses of the bromides are well borne.

The bromides are just as efficacious as the iodides in eliminating lead from the system—a fact which, although not generally known, is vouched for by so good an authority as Professor Rutherford, of Edinburgh.

From the influence of the drug on the sexual system, the bromides may be given in full doses in the treatment of nymphomania and satyriasis.

There are few better remedies than the bromides for spermatorrhœa. Nearly all the concoctions, so largely advertised in the daily press for this affection, contain one or more of the bromides. The directions which accompany these nostrums are probably not without value. It is generally said that while the patient is taking the medicine he should sleep on a hard bed with little bed-clothes; his hours of sleep are to be strictly limited, and he should get up at once when called in the morning. A cold-bath is to be taken daily, and the patient is to bathe his testicles in cold water every night when going to bed, although this latter plan has been accused of a tendency to excite a reactive hyperæmia of the parts which is prejudicial to their physiological repose. He should take little stimulants, and no grog at bedtime. He must be careful in the choice of literature, and especially should avoid reading quack works. He should take plenty of exercise, go in for cricket or foot-ball, or join a gymnasium or the volunteers. A commonly-recommended auxiliary mode of treatment is to tie a spool round the loins, so that if the patient lies on the back he is uncomfortable, and turns over on to the side, it being found that wet dreams occur more commonly in the supine position.

Bromide of potassium has been given in the treatment of tetanus, usually in large doses, and sometimes in combination with physostigma.

In strychnine-poisoning, half an ounce of bromide of potassium should be given to begin with, and this should be followed by drachm-doses every ten minutes, either with or without chloral.

The dose of bromide of potassium, sodium, or ammonium, is usually said to be from 15 to 20 grains, but they are often prescribed in very much larger doses. From 40 to 60 grains, three times a day, may be given for a day or two without producing inconvenience, and there is no doubt that, in many cases, very large doses of bromides may be given for very long periods without the production of untoward effects.

Dr. Hughes Bennett has recorded several cases in which patients have taken a drachm and a half of bromide of potassium daily for six years without inconvenience. He mentions the case of a man, æt. 30, who suffered from epilepsy from infancy, and who for five years took four drachms and a half of the bromides daily, *i.e.*, during that time he consumed upward of 80 pounds of the drug. He also points out that, in many cases, while the beneficial action of the drug remained, their deleterious effects steadily diminished as long as the drug was taken. The most marked effects of bromism usually appear at the beginning of the treatment, and the eruption and physical and mental depression disappear, although the administration of the medicine is continued.

Bromide of potassium is commonly given in a mixture flavored either with spirit of chloroform or syrup of orange.

A good formula is: Bromide of potassium, twenty grains; syrup of wild-cherry, one drachm, and water sufficient to make a fluidounce; to be taken three times a day.

The elixir of bromide of potassium, now frequently prescribed, is palatable, and the tablets, containing five grains in each, are convenient for administration. The bromide of sodium (as already pointed out) can be advantageously given in place of common salt, and may be taken with food.

The following was Brown-Séquard's favorite prescription for epilepsy :

℞	Potassii Iodidi,	ʒ j.
	Potassii Bromidi,	℥ ij.
	Ammonii Bromidi,	ʒ ijss.
	Potassii Bicarbonatis,	gr. xl.
	Infus. Calumbæ,	ad ℥ vj.

M.—A teaspoonful before each meal, and three teaspoonfuls at bedtime, with a little water.

This is a good example of a prescription containing all three bromides. The dose of the combined bromides actually taken by the patient is a little bit doubtful, as teaspoons vary much in size; but it was probably from fifteen to twenty grains before meals, and about a drachm at bedtime. It would have been better to have said, "twice a day," or "three times a day," before meals, unless verbal directions were given to the patient as to the number of meals to be eaten. Mixtures containing bromides are usually given after meals, but this was probably ordered to be taken before meals for the sake of the tonic effect of the calumba. The dose of infusion of calumba is very small, and it might have been better to have substituted the tincture of calumba with the spirit of chloroform.

Bromide of Strontium can now be obtained in a sufficient state of purity for medicinal use. It is freely soluble in water, and is usually given in doses of from twenty to twenty-five grains three times a day. It is claimed for it that it never produces a rash; but on several occasions I have known it to bring out a well-marked acne. It is, however, a useful salt, and it is not unlikely that it will come into more extensive use.

Bromide of Lithium is a white, granular salt, very deliquescent, odorless, possessing a sharp and somewhat bitter taste. It contains twice as much bromine as the potassium salt. Its use is advocated by Dr. S. Weir Mitchell, who claims for it that it is more hypnotic than the other bromides. It is said to be useful in calming the irritability of gouty patients. The dose is from 15 to 20 grains.

Bromide of Zinc is very deliquescent—so deliquescent, in fact, that it has to be kept in small, glass-stoppered vials. Both bromine and zinc are used in the treatment of epilepsy, and it was thought that the combination might prove doubly efficacious. Unfortunately, in large doses it acts as an irritant poison. Dr. Hammond uses a syrup of bromide of zinc, made by dissolving 480 grains in 4 fluidounces of syrup. The dose of this is 10 drops three times a day, increased to 40 drops four times a day. The ordinary dose is from 3 to 10 grains, well-diluted.

Bromide of Manganese (which contains 75 per cent. of bromine) has also been used. There are three objections to it: First, it causes headache, even in doses of a few grains; secondly, it is so bitter that, when added to a bromide combination, it gives an unpleasant taste to the whole mixture; and, finally, it has no special advantage over the other bromides.

[**Hydrobromic Acid** acts, in some degree, like the saline bromides and, like them, is sometimes used to relieve the effects of cinchonism upon the nervous system. It has been suggested that the addition of a small amount of dilute hydrobromic acid to the mixture of bromides given in epilepsy would be serviceable.

In prescribing the bromides, it should be borne in mind that most of them are very hygroscopic and that, when dispensed in their ordinary state, they should be carefully guarded from atmospheric moisture. Also, it may be said, that iced water greatly lessens their taste if they are to be taken in the form of a solution.

Bromide of Arsenic has had some use as a remedy in diabetes and epilepsy.]

IODINE AND IODIDES

Iodine crystals at first sight are not altogether unlike graphite or black-lead. They consist chiefly of scales or plates having a shiny, metallic appearance, and a characteristic, irritating, pungent odor. When the bottle containing them has been standing in the sun the upper part contains a little violet vapor. The name is derived from ἰώδης=violet, in reference to the violet fumes given off when iodine is heated. It is but slightly soluble in water, but dissolves readily in alcohol. One of the best solvents is a watery solution of iodide of potassium.

Action.—The constitutional symptoms resulting from the administration of iodine are best considered when speaking of the iodides.

When applied to the skin in the form of a solution, iodine produces a yellowish-brown discoloration, followed by a sensation of warmth and itching. When the solution is strong, it causes pain, and the application may produce desquamation or even vesication. In addition to being rubefacient, iodine is counter-irritant and promotes absorption. The liniment and tincture are often painted on the chest and on enlarged joints, so that the effects are readily observed. It must be remembered that the liniment [of the Br. Pharm.] is by far the stronger preparation, and that a single coat, applied with a brush, is usually sufficient. Should the application give rise to much pain, the iodine may be removed by any spirit, such as gin, whiskey, brandy, or *eau de Cologne*; but a saturated solution of iodide of potassium is still better. A linseed poultice usually eases the pain, but a hypodermic injection of morphine may be required to give complete relief.

Tincture of iodine, applied locally, acts as a parasiticide and is used in ringworm to destroy the fungus. Another useful application for this purpose is "Coster's paint," made by adding (with the application of heat, if necessary) two drachms of iodine to an ounce of oil of tar.

Taken internally, in the form of tincture, iodine acts as an irritant to the stomach and intestines, giving rise to catarrh of the mucous membrane.

In the form of liniment or tincture, it is painted over the chest and back to promote absorption of fluid in cases of chronic pleurisy, and under and above the clavicles to allay the cough of phthisis. Applied all over the back and front of the chest, it is useful in bronchial catarrh and chronic bronchitis. Applied to joints, it relieves the pain of gout, rheumatism, and chronic synovitis.

An ointment, being commonly a weak preparation, is well adapted for children, and is a useful application for chilblains before they are broken.

The inhalation of iodine is useful in fibroid phthisis, especially when the expectoration is abundant and the cough is troublesome. The vapor may be obtained by adding ten drops of tincture of iodine to a pint of water at 135° F. and inhaling the steam. A stronger preparation is often used, but this answers well.

Ten drops of tincture of iodine in a wineglassful of water is one of the remedies recommended for sea-sickness.

The so-called colorless iodine is made by adding strong solution of ammonia to tincture of iodine and leaving it in a warm place until it has lost its color. It is true it does not stain the skin, but it is equally true that it does not produce anything like the same effect as tincture of iodine when used as a counter-irritant.

[PREPARATIONS.—Liquor Iodi Compositus, 5 per cent.; Tinctura Iodi, 7 per cent.; Unguentum Iodi, 4 per cent.]

IODIDES

ACTION.—When any of the iodides are given for some time they may produce a train of symptoms to which we apply the term iodism. This is entirely and essentially different from bromism, its characteristic symptoms being as follows:

Running at the eyes and nose; sneezing; frontal headache; injection of the conjunctivæ, with abundant flow of tears, and a swollen, reddened, and œdematous condition of the tissues about the orbit, together with smarting and tingling of these parts.

A rash not infrequently appears over the whole body, and may be acne, or may assume a petechial form. It often begins in the region of the nose and extends to the chin; the nose, at the same time, being reddened and swollen at the tip. Eruptions due to the iodides are sometimes developed after one or two doses, and, in addition to acne and petechial forms, erythematous, vesicular, and bullous eruptions may occur, some of them resembling syphilitic eruptions. If the drug is pushed these conditions may be aggravated. In one instance death has resulted. Arsenic is said to have some power in controlling their appearance, but idiosyncrasy has much to do with it. In some cases these symptoms are absent, but there is gastric disturbance; the patient suffering from nausea, a sensation of sinking at the pit of the stomach, loss of appetite, and watery diarrhœa. Sometimes all these symptoms are absent, but the patient experiences intense depression both of mind and body; is irritable, dejected, listless, wretched, and fit for nothing.

Some patients are so exceptionally susceptible to the action of iodine that a single grain of either iodide of potassium or of sodium will produce some or all of these symptoms. Sometimes a patient will take one salt of iodine without difficulty when another disagrees. The aromatic spirit of ammonia added to an iodide of potassium mixture, is said to prevent the occurrence of iodism. It probably acts by converting the potassium into an ammonium salt. Syrup of iodide of iron has been known to produce iodism. "Clarke's Blood Mixture" consists of iodide of potassium, forty-eight grains; chloric ether, four drachms; solution of potash, half a drachm, and water (colored with burnt sugar) to eight ounces. Cases of iodism from its administration must be of common occurrence.

The iodides, when taken into the stomach, are very rapidly absorbed. It is probable that all iodides form combinations in the blood with chloride of sodium and act as iodide of sodium. It is possible, however, that the iodine may be set free and may enter into combination with albuminous substances. This may throw some light on its mode of action in promoting the absorption of gummatous and other growths. The entrance of a molecule of iodine into the composition of the albuminous material may favor its metamorphosis and disintegration. Lead and mercury are set free from the tissues by iodine and are rapidly eliminated. It is said that the iodides sometimes cause salivation, but this is only indirectly true. They give rise to salivation only in those who have previously taken mercury. The mercury having been deposited in the form of an albuminate, on the administration of an iodide it is brought once more into the circulation and produces its constitutional effects.

Iodides are eliminated by the kidneys, and may be detected in the urine a few minutes after a dose has been taken. So, too, iodine has been detected in blood, saliva, urine of nurslings, and in most of the secretions. Probably some iodine is eliminated by the skin and causes the rash. A popular method of demonstrating the presence of iodine in the saliva is to put a bright shilling in the mouth for a few minutes, when it rapidly becomes discolored.

THERAPEUTICS.—The iodides are of the greatest possible value in what is commonly called tertiary syphilis, that is, in the treatment of those symptoms which sometimes appear many years after a patient has had an attack of syphilis. They may assume various forms, and, for a time, their nature may not be recognized. The patient may suffer from chronic and relapsing periostitis; from muscular pains, nodes, or gummata in the substance of the muscles; from diseases of the skin of a lupoid type; from locomotor ataxy; from paralysis of certain special nerves, such as the fifth, or the facial, or from symptoms of commencing general paralysis. In all these cases the iodides do good. It is probably not a matter of any particular importance which of the salts is given; but the sodium salt produces less depression than the potassium salt. A good many authorities give all three iodides—potassium, sodium, and ammonium—together, and some think that the addition of half a drachm of sal-volatile to each dose is a decided advantage. It is probably best to begin with a small dose of the iodides—say three to five grains, three times a day, after meals—and gradually to increase it to ten or even twenty grains three times a day. A favorite combination among surgeons is a mixture containing one-sixteenth of a grain of bichloride of mercury; five grains of iodide of potassium; half a drachm of sal-volatile, and fifteen minims of spirit of chloroform, in an ounce of water.

The iodides are also indicated in rheumatic and gouty conditions. They are especially indicated when the pains are "worse at night." They are likewise of great value in the treatment of saturnine gout, that is to say, gout resulting from chronic lead-poisoning. Patients who find that iodide of potassium depresses them should take iodide of sodium. The iodine combines with the lead, and sodium with the uric acid. Most people can take five grains of iodide of sodium and ten minims of colchicum wine three times a day, without inconvenience.

The risk of producing absorption or atrophy of the mammæ or testicles from a prolonged use of the iodides is very small; but, at the same time, it must be admitted that permanent depression of the sexual function may occur. It has been pointed out that certain "blood-purifiers" contain large doses of iodide of potassium; and it would probably lead to very interesting discussion in the event of a patient, who had taken one of these combinations, claiming damages for the loss of his virile power from the action of the iodide of potassium.

Red iodide of mercury and some other iodides are used, not for the sake of the iodine, but for the action of the base and, although chemically iodides, are not considered from that point of view by pharmacologists.

Iodide of Lead is used in the preparation of the plaster and ointment of iodide of lead. Applied externally, they act as mild irritants and are useful in the treatment of chronically inflamed joints.

[PREPARATIONS.—Ammonii Iodidum ; Argenti Iodidum ; Arseni Iodidum ; Ferri Iodidum Saccharatum ; Hydrargyri Iodidum Flavum ; Hydrargyri Iodidum Rubrum ; Liquor Arseni et Hydrargyri Iodidi, 10 per cent.; Pilulæ Ferri Iodidi, 1 gr.; Plumbi Iodidi ; Potassii Iodidi ; Sodii Iodidi ; Strontii Iodidi; Sulphuris Iodidi; Syrupus Ferri Iodidi, 10 per cent.; Unguentum Plumbi Iodidi, 10 per cent. ; Unguentum Potassii Iodidi, 12 per cent.; Zinci Iodidi.]

SULPHUR AND ITS COMPOUNDS

There are two kinds of sulphur used in medicine :

Sublimed Sulphur is a bright-yellow, gritty powder, without taste or smell. It is volatile, insoluble in water, soluble in hot oil of turpentine, and in fixed oils, such as olive oil. There was formerly a preparation known as "balsam of sulphur," made by dissolving sulphur in oil.

Precipitated Sulphur has the same physical characters as sublimed sulphur, with the exception that it is lighter in color, in consequence of its finer state of subdivision—being made by precipitation—and that it is not gritty. There is no difficulty in distinguishing sublimed from precipitated sulphur. By daylight their color is the best test, sublimed sulphur being of a citron or bright-yellow color, whilst precipitated sulphur is pale-yellow. By gaslight it is difficult to distinguish colors, and then their consistency is the best guide, sublimed sulphur being gritty, whilst the precipitated, from its more minute state of subdivision, is quite smooth. When precipitated sulphur is improperly prepared with sulphuric instead of hydrochloric acid, it contains crystals of sulphate of lime, which are readily detected under a microscope. Sublimed sulphur never contains these crystals.

Stick Sulphur is used in medicine only as a source of sulphurous acid for disinfecting purposes.

ACTION.—Respecting the changes which sulphur undergoes in the body, very little is known. When brought in contact with living protoplasm it probably enters into combination and forms sulphurous acid or sulphuretted hydrogen. It is eliminated partly with the fæces, in form of sulphides; partly by the urine, in the form of sulphates; and partly by the skin, breath, and intestines, as sulphuretted hydrogen. The breath of patients taking sulphur smells of sulphuretted hydrogen, and articles of silver worn as ornaments turn black.

THERAPEUTICS.—Sulphur is a laxative, being the mildest form of purgative, increasing only slightly the action of the bowels, and not producing watery motions.[1] Sulphur has little action on the secretions, but purges by stimulating the involuntary muscular tissue to increased contraction. It produces soft, semi-solid motions, so that it is used not only in constipation, but in piles, fissure of the anus, and stricture of the rectum. The compound liquorice powder contains sulphur, senna, liquorice, and fennel, and is a useful preparation.

Sulphur is anti-parisiticide and, in the form of an ointment, is largely used in the treatment of itch. It is often maintained that the sulphur plays no part in the destruction of the acarus, but that the fat, by obstructing its breathing-pores, suffocates and so destroys it. This view is untenable, for sulphur ointment is much more effectual than simple lard. It is probable that sulphuretted hydrogen is formed and, being a powerful toxic agent, destroys the itch-insect.

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[1] Other examples of laxatives are figs, prunes, honey, treacle, manna, tamarinds, and magnesia. Oatmeal, brown-bread, bran-biscuits, and many fruits are also laxative, some of them producing their effect by the stimulation of peristaltic action caused by the presence of small seeds or other indigestible particles.

Sulphur is a mild expectorant, being used for this purpose in cases of old-standing bronchitis.

Sulphur could not be readily given in a fluid form, on account of its insolubility, and it could not be prescribed as a pill, because the dose is too large. It is, therefore, somewhat customary to administer it in the form of a confection or electuary—a semi-solid, sticky substance, usually having honey or syrup as a basis, of which the dose is about a teaspoonful.[1]

Sulphur is frequently employed externally, in the form of a poultice, in chronic rheumatism and chronically-inflamed joints. The poultice should be made in the same way as a linseed-meal poultice, equal parts of linseed meal and precipitated sulphur being employed. Some people make the poultice first of linseed meal, and then spread sulphur on its surface.

It is a common custom in cases of rheumatism, sciatica, and lumbago to freely dust the inside of stockings and drawers with sulphur, and the same treatment is frequently resorted to in chronic skin diseases, such as eczema and psoriasis.

Sulphur Lozenges are sometimes known as Garrod's lozenges, from their recommendation by Sir Alfred Garrod, in 1889, for the treatment of certain chronic affections of the alimentary canal, liver, skin, and joints. They are composed of precipitated sulphur, acid tartrate of potassium, refined sugar, gum acacia, tincture of orange-peel, and mucilage of acacia. Each contains five grains of sulphur with one grain of acid tartrate of potassium, and the dose is from one to six lozenges. The usual plan is to prescribe one at night, sometimes two, sometimes one night and morning. The acid tartrate of potassium is added to increase purgative action.

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[1] Another good example of a confection is the confection of senna, which is often given with confection of sulphur, as a laxative. Such substances as iodide of potassium or bromide of potassium are not given as confections, because they are readily soluble in water. Calomel, although insoluble, is not prescribed as a confection, because it is an active drug and accuracy of dosage is essential. As a rule, confections consist of drugs which are insoluble, the dose of which is large, and which are not very active. Some confections—such as the confection of roses—are used simply as vehicles for the administration of other drugs.

The following is a useful formula for an ointment in cases of scabies :

Sulphur,	ʒ ss.
White Precipitate,	gr. iv.
Creasote,	gtt. iv.
Oil of Chamomile,	gtt. x.
Lanolin Ointment,	℥ j.

It should be rubbed in, night and morning, especially between the fingers. On the fourth day a hot bath is to be taken and the linen changed.

For acne of the face, especially in that form which occurs commonly in young women, a sulphur lotion will be found useful.

Precipitated Sulphur,	ʒ j.
Glycerin,	℥ j.
Elder-flower Water,	℥ vj.
Rose Water,	to Oss.

This lotion, after being well shaken, should be applied freely to the face, superfluous sulphur being dusted off with a soft handkerchief.

Another good application for acne is :

Precipitated Sulphur,	
Sulphurated Lime,	
Phosphate of Lime,	āā ℥ ss.
Heliotropin,	gr. v.

The powder, mixed with a little water, is applied first to all the inflamed and painful pustules, after which other portions affected with acne are simply dusted over with the powder.

Cure is usually effected within a few days.

The usual dose of sulphur for internal use is from thirty to sixty grains, but more may be given. It may be administered in milk, in the form of a confection, or in lozenges. The old-fashioned remedy, brimstone and treacle (sulphur and molasses), is well-known. Sulphur is useful in all forms in chronic constipation, and is frequently employed to insure a copious and easy evacuation in cases of piles, fissure of the anus, and fistula.

Fumes of sulphur are employed with advantage for disinfecting sick-rooms after the occurrence of scarlet-fever, diphtheria, and other contagious diseases. The windows, doors, and other apertures should be carefully closed, and metallic articles, such as the fender and fire-irons, removed or covered with grease. Stick-sulphur should then be placed in an old metal vessel, such as a saucepan, and covered with methylated spirit, which can then be lighted. It is a good plan to support the pot on a pair of tongs placed over a pan containing water, to prevent danger from its upsetting. When the sulphur is well alight the room should be left closed for some hours, after which it should be exposed to a thorough draught of air from the open door and windows for several hours. [Articles of clothing or fabrics which are wet or damp are liable to injury on account of the formation of sulphuric acid when sulphur fumes come into contact with water. Therefore the air of the room should also be dry, if possible.]

[PREPARATIONS.—Sulphur Lotum; Sulphur Præcipitatum; Sulphur Sublimatum; Unguentum Sulphuris, 30 per cent.; Pulvis Glycyrrhizæ Compositus, 8 per cent.]

Sulphurous Acid [is a liquid composed of not less than 6.4 per cent., by weight, of sulphurous acid gas dissolved in water]. It is a colorless liquid, having a powerful odor of burning sulphur. When evaporated it leaves no residue.

USES.—It is a deodorizer and a disinfectant. It arrests putrefaction and fermentation by destroying the organisms on which the processes depend.

Sulphurous acid is a parasiticide and, in the form of a bath, is frequently used in the treatment of scabies.

In chloasma or tinea versicolor (a parasitic skin disease depending on the presence of a fungus known as *Microsporon furfur*) the sulphurous acid solution, mixed with an equal quantity of water or glycerin, is used as a local application. The skin should first be washed with soap, to get rid of the greasy condition it often presents, and then dabbed over freely with aromatic vinegar, to neutralize the alkali of the soap, after which a few applications of the lotion will speedily destroy the parasite. It is recommended in the treatment of tinea tonsurans or ringworm; but fails to give satisfactory results unless a saturated solution of sulphurous acid in glycerin is substituted for the aqueous solution. It is used for chilblains and chapped hands and, in the form of a spray, is useful in many throat affections and in some forms of chronic bronchitis and phthisis, especially when the expectoration is offensive. It is antiseptic, and is given to check fermentation in the treatment of pyrosis or waterbrash and in flatulence.

The Sulphites are not used in medicine, but hyposulphite of sodium is a valuable drug. Its uses are practically identical with those of sulphurous acid, it being simply sulphurous acid in combination with a base. It was at one time recommended as a remedy for phthisis; but its use is now confined almost exclusively to the treatment of flatulence. The dose is from ten to sixty grains, and it may be conveniently given in any aromatic water.

A solution of hyposulphite of sodium, of a strength of a drachm to the ounce of water, may be used for removing iodine stains from the hands.

The Sulphides are valuable remedies. Sulphurated potash is known as "hepar sulphuris," or liver of sulphur. Sulphurated lime is "hepar calcis," or liver of lime.

Many natural waters contain the sulphides, as, for example, Harrowgate, in Yorkshire; Strathpeffer, in Scotland; Barèges, in the Pyrenees, and the Blue Lick, in Kentucky.

Sulphurated lime is the favorite salt for internal administration. It is a dirty-white powder, with a disagreeable taste and a marked sulphuretted odor. It is partly decomposed by the acid of the stomach, so that patients taking it complain of disagreeable eructations of sulphuretted hydrogen gas.

It is used in the treatment of boils and carbuncles, a tenth of a grain tablet or pilule being taken every three hours, or even every hour. It will check the formation of pus in the early stage, or, if given later, will promote its discharge and conduct the process to a favorable termination. It is also useful in the treatment of acne and of enlarged glands of the neck, especially of scrofulous children. It is recommended for scrofulous sores and for diseased bones of scrofulous subjects. It is useful in abscess of the breast, and, in fact, in all kinds of chronic abscess.

Sulphurated lime is a powerful toxic agent and cannot be given in unlimited quantities. It is safe to give half a grain at a dose, but it is better to give a tenth of a grain, in the form of a pilule, every three hours. It is an excellent remedy, and one on which the greatest reliance can be placed.

Sulphurated potash is commonly employed for baths, the proper strength, according to Dr. C. D. F. Phillips, being half a pound to thirty gallons of water. These baths are useful in many chronic skin diseases, especially eczema and psoriasis, but they should not be used in the acute stage. They are also prescribed in the treatment of itch, chronic gout, chronic rheumatism, chronic rheumatoid arthritis, and chronic lead poisoning.

[PREPARATIONS.—Antimonii Sulphidum Purificatum; Antimonium Sulphuratum; Calx Sulphurata; Potassa Sulphurata.]

PHOSPHORUS AND ITS COMPOUNDS

There are two kinds of phosphorus—white or stick phosphorus, which is official, and amorphous phosphorus. The white variety is soluble in ether, oils, naphtha, and bisulphide of carbon, whilst the red is insoluble in bisulphide of carbon. Stick phosphorus is a powerful medicinal substance; but the red variety is inert, and has been given in half-drachm doses, three times a day, for forty days, without producing any symptom.

ACTION.—When phosphorus is given to animals for a long time the condition of the bones becomes altered in a remarkable way. Where spongy bone should be formed, dense osseous tissue takes its place. This deposit does not result from an excess of phosphates in the blood, but is the result of stimulation of tissue-growth by the phosphorus itself.

Workmen exposed to the fumes of phosphorus in match manufactories are liable to necrosis of the jaw, due to the direct action of the phosphorus on the bare bone, and does not occur unless the patient has either bad teeth or a wound or sore about the mouth. This malady was at one time common in lucifer-match manufactories, the "dippers," or people who dip the slips of wood in the inflammable composition, being the chief sufferers. Since the introduction of safety-matches made with red phosphorus, the disease is far less common than formerly. This condition does not result from the internal administration of phosphorus.

Phosphorus given internally may, by its stimulating and irritating action, cause excessive development of the fibrous tissue of the liver. If its administration be continued it may give rise to fatty degeneration of the stomach, liver, kidneys, heart, and voluntary muscles, due to a rapid splitting up of all albuminous tissues, with deficient oxidation, and takes place even when fatty food is not administered.

When given in large doses, phosphorus produces a burning sensation in the throat, intense thirst, pain in the stomach, followed by distension of the abdomen and vomiting of a dark-green or black substance, having the odor of garlic and which is phosphorescent in the dark. The patient exhibits symptoms of collapse, and, in the course of a few hours, or perhaps days, there may be noticed tenderness over the liver, jaundice, diarrhœa, and scanty albuminous urine containing blood. There are usually extensive subcutaneous hæmorrhages, with an eruption of petechial spots. It has been found that wounds or sores bleed profusely, and after death the tissues are seen to be in a condition of fatty degeneration. The liver may be enlarged, with its cells in a state of advanced fatty degeneration, or it may be contracted from destruction of its cells. This fatty degeneration affects the whole of the arterial system, involving even the smallest arterioles. Jaundice is probably due to catarrh of the small biliary ducts, which causes obstruction and leads to absorption of bile.

Very marked effects are said to follow in some cases the administration of phosphorus in ordinary doses, such as improvement in the appetite ; quickened pulse ; heightened temperature ; copious secretion of urine loaded with lithates ; sharpening of the mental faculties ; increase in muscular power ; general sense of well-being, together with some increase in sexual appetite. These symptoms are not of constant occurrence and, undoubtedly, in very many people are never experienced.

Under the influence of phosphorus, excretion of urea is diminished, and products of nitrogenous disintegration appear in the urine as leucin or tyrosin. Phosphorus gives the urine a smell of violets in some cases. Phosphorus is allied in physiological action to vanadium, the salts of which produce fatty degeneration of the liver.

THERAPEUTICALLY it is chiefly employed in the treatment of impotence resulting from what is commonly called nervous exhaustion. There are many varieties of pill which are used in this condition, of which the following are suggested:

1.	Phosphorus,	gr. $\frac{1}{50}$
	Strychnine,	gr. $\frac{1}{30}$
	Dried Sulphate of Iron,	gr. ij.
	Extract of Aloes,	gr. j.
2.	Phosphorus,	gr. $\frac{1}{50}$
	Reduced Iron,	gr. iij.
	Strychnine,	gr. $\frac{1}{30}$
	Sulphate of Quinine,	gr. j.
3.	Phosphorus,	gr. $\frac{1}{33}$
	Extract of Nux-vomica,	gr. $\frac{1}{8}$
	Extract of Damiana,	gr. iij.

Reliable phosphorus pills can be made with cocoa-butter.

Phosphorus is sometimes given in capsules, and a solution in ether is by no means a bad form.

The following formulas are recommended by the British Pharmaceutical Conference:

TINCTURA PHOSPHORI COMPOSITA

Phosphorus,	grs. xij.
Chloroform,	fl. ℥ ijss.

Place in a stoppered bottle and apply the heat of a water-bath until dissolved. Then add the solution to

Ethylic Alcohol, fl. ℥ xijss.

Shake well. This tincture should be preserved from the light, in accurately stoppered bottles. It deteriorates if long kept. Each fluidrachm contains $\frac{1}{10}$ grain of phosphorus, and the dose is from 3 to 12 minims.

ELIXIR PHOSPHORI

Compound Tincture of Phosphorus,	fl. ℥ iv.
Glycerin,	fl. ℥ xvj.

Add the tincture to the glycerin, and shake well. This elixir should be freshly prepared and preserved from the light in full bottles. Each fluidrachm contains $\frac{1}{50}$ grain of phosphorus, and the dose is from 15 minims to 1 fluid-drachm.

[PREPARATIONS.—Elixir Phosphori, $\frac{1}{65}$ gr. per drachm; Oleum Phosphoratum, 1 per cent.; Pilulæ Phosphori, gr. $\frac{1}{100}$; Spiritus Phosphori, 0.12 per cent.]

Phosphates.—Phosphate of calcium may be taken as a type of the phosphates. It is a white, tasteless, odorless powder, quite insoluble in water. Its action is due partly to the lime it contains, and partly to the phosphorus. It is an important constituent of the body, and plays an active part in the formation of bone and in giving solidity to the skeleton. It forms the first basis of new tissues, and where cell growth is active it is always found in increased quantity. In animals, fractured bones unite more speedily when phosphate of lime is administered. It is useless to give it in large quantities, for its diffusion-power is small. It is probably acted on by the acids of the stomach; but much of it passes unaltered into the intestines, and some of it is eliminated with the fæces.

Phosphate of lime is useful in the anæmia of young and rapidly-growing girls; and is especially indicated in the case of women weakened by child-bearing, prolonged suckling, or excessive menstruation. The following is a good formula:

Phosphate of Lime,
Phosphate of Iron,
Saccharated Carbonate of Iron, āā gr. j.
Sugar of Milk, gr. ij.

To make a powder. One to be taken three times a day, after meals.

[PREPARATIONS.—Calcii Phosphas Præcipitatus; Ferri Phosphas Solubilis; Sodii Phosphas; Syrupus Calcii Lactophosphatis, gr. 1.48 to ʒi.; Syrupus Ferri, Quininæ et Strychninæ Phosphatum, F. 2 per cent., Q. 3 per cent., S. 0.02 per cent.]

Hypophosphites.—The hypophosphites of lime and of sodium are the ones most used. When heated to redness they ignite, evolving spontaneously-inflammable phosphuretted hydrogen. They hold their phosphorus in weak chemical combination and present some of the therapeutic properties of that drug. These substances are undoubtedly of much value as medicinal agents, especially in the treatment of consumption ; but respecting their pharmacological action it is difficult to meet with trustworthy data.

"Fellows' Syrup of the Hypophosphites" contains the hypophosphites of iron, lime, manganese, and potassium, with three-quarters of a grain of quinine and one sixty-fourth of a grain of strychnine in each drachm.

The following formulas have been adopted by the British Pharmaceutical Conference:

LIQUOR HYPOPHOSPHITUM COMPOSITUS

Hypophosphite of Calcium,	gr. cccxx.
Hypophosphite of Sodium,	gr. cccxx.
Hypophosphite of Magnesium,	gr. clx.
Strong Solution of Hypophosphite of Iron,	fl. ℥ vj.
Hypophosphorous Acid (30 per cent.),	fl. ℥ ss.
Distilled Water,	a sufficient quantity.

Dissolve the hypophosphites of calcium, sodium, and magnesium in twelve fluidounces of distilled water ; add the solution of hypophosphite of iron and the hypophosphorous acid. Filter, and make up to one pint by the addition of distilled water.

Each fluidrachm contains 2 grains each of hypophosphite of sodium and calcium, 1 grain of hypophosphite of magnesium, and 1½ grains of hypophosphite of iron.

The dose is from ½ to 2 drachms.

SYRUPUS HYPOPHOSPHITUM COMPOSITUS

Quinine (alkaloid),	gr. xx.
Strychnine,	gr. j.
Hypophosphorous Acid (30 per cent.),	fl. ʒ ij.
Strong Solution of Hypophosphite of Iron,	fl. ℥ iij.

Dissolve, and add

Hypophospite of Calcium,	gr. lxxx.
Hypophosphite of Manganese,	gr. xl.
Hypophosphite of Potassium,	gr. xl.

Dissolve, filter, and add

Syrup, sufficient to produce Oj.

Mix. Each fluidrachm contains $\frac{1}{160}$ grain of strychnine and $\frac{1}{8}$ grain of quinine. The dose is from $\frac{1}{2}$ to 2 fluidrachms. This preparation will be found useful in the treatment of phthisis and as a tonic.

[Preparations.—Calcii Hypophosphis; Ferri Hypophosphis; Potassii Hypophosphis; Sodii Hypophosphis; Syrupus Hypophosphitum, Cal. 4.5 per cent., Pot. 1.5 per cent., Sod. 1.5 per cent.; Syrupus Hypophosphitum cum Ferro, 1 per cent.

ACIDS

The three acids—hydrochloric, sulphuric, and nitric—may be conveniently considered together.

There are two medicinal preparations of hydrochloric acid—the diluted [containing 10 per cent. of absolute acid] and the diluted nitrohydrochloric; two preparations of sulphuric acid—diluted sulphuric acid and aromatic sulphuric acid [the former containing 10 per cent. of absolute acid, and the latter 20 per cent. of the official sulphuric acid, partly in form of ethyl-sulphuric acid], and two preparations of nitric acid—diluted nitric acid [10 per cent. of absolute acid] and diluted nitrohydrochloric acid [4 per cent. of nitric and 18 per cent. of hydrochloric].

Action.—The fumes of all these acids act injuriously on animal and vegetable life. In the neighborhood of manufactories where carbonate of sodium is prepared from common salt, the vapor of hydrochloric acid, if not condensed, destroys all vegetation for miles around. The same thing occurs in the extraction of copper from pyrites; the manufacture of common glass bottles; in brick and cement-burning, and in some other trades. Cases are recorded where the air has been so fully impregnated with fumes as to induce spasm of the glottis in casual passers-by. The destruction of animal and vegetable life by this means is a frequent cause of complaint, and often leads to litigation. By the "Alkali Act" [of Great Britain], manufacturers have to condense ninety-five per cent. of the gas which may be produced by the materials used, and there must not be more than a fifth of a grain of gas per cubic foot of air leaving the works.

All the members of the group have a strong affinity for alkalies; and some, such as sulphuric acid, absorb water with avidity. They have a high diffusion-power, so that they pass readily through animal membranes and textures. When applied to the skin they destroy the tissues to a considerable depth; penetrating until they are neutralized by the bases with which they come in contact.

Sulphuric acid possesses this power to a remarkable degree, and acts as an escharotic, destroying the tissue with which it comes in contact. Around the part destroyed inflammation ensues, and an eschar (or portion of dead tissue) separates. The diluted acids act as astringents, and check hæmorrhage by constringing blood-vessels and coagulating the blood.

Given internally *acids check acid secretions and promote alkaline secretions.* This is the key to their action. The saliva is alkaline, and acids promote its secretion—an explanation of the use of acid drinks in checking thirst. The gastric juice is acid, and an acid given before meals checks its excessive formation and relieves acidity. Acids given after meals aid digestion, not by increasing the secretion of the gastric juice, but by rendering it more acid.

A consideration of the fact that weak alkaline solutions —such as saliva—increase the secretion of the gastric juice, affords an explanation of the common experience that meals which are well-cooked and appetizing are easy of digestion. The sight and smell of food make the mouth water and, as the saliva is swallowed, gastric secretion is stimulated. We have also an explanation of the common use of vinegar with the view of reducing obesity. The vinegar, taken before meals, checks secretion of the gastric juice, and prevents digestion and assimilation. A case is recorded of a lady who habitually took large doses of vinegar in this way, and ultimately died of emaciation.

Acids are, for the most part, absorbed by the stomach, passing into the blood where they combine with bases and set free weaker acids. Their action on the blood must be insufficient to affect its reaction, for tissues are nourished only by blood which is either neutral or alkaline. In rabbits, death may ensue from abstraction of the alkalies of the blood, caused by the administration of large doses of acids.

Any acid which escapes into the intestine is neutralized by the biliary and pancreatic secretions. The bile being alkaline, its secretion would be promoted by the presence of an acid, and this may partly explain the action of acids in stimulating the liver and relieving that organ when congested. In the same way they promote the flow of intestinal secretions. It is probable that acids, as such, never reach further than the duodenum. If absorbed from the duodenum they must pass through the liver on their way to the blood, and may stimulate its tissues in the process.

Acids are usually eliminated by the kidneys in combination with ammonia; but if given in large doses they increase the acidity of the urine.

Acids—such as nitrohydrochloric, citric, and acetic—diminish excretion of urea, a fact which affords ready explanation of the tendency of young and acid wines to produce gout.

Citric and **tartaric acids** have the same action as the mineral acids, but in a milder form. They are said to be refrigerant, although there is no definite evidence that they reduce the temperature.

Citric acid is used for making artificial lemon-juice, the formula for which is:

Citric Acid,	gr. ccx.
Freshly-prepared Mucilage of Acacia,	ʒ iij.
Simple Syrup,	℥ i.
Distilled Water,	℥ vss.

Diluted hydrochloric acid is frequently prescribed in cases of dyspepsia. Given after meals, it is useful in cases of atonic dyspepsia and helps digestion. In cases of acidity, where sour fluid regurgitates into the mouth and sets the teeth on edge, the diluted acid should be given before meals.

If given in ten or fifteen-minim doses, it can be made into a palatable mixture with spirit of chloroform, syrup of orange-peel, and tincture and infusion of gentian, calumba, or chiretta.

Freely diluted and used as a bath, nitrohydrochloric acid is a rubefacient and reddens the skin. The ordinary nitrohydrochloric acid-bath is made by adding a pound of nitric, and a pound and a half of hydrochloric acid to thirty gallons of water. It is very often prescribed in cases of chronic jaundice and chronically enlarged liver. The fumes given off are apt to irritate the eyes and nose. This makes a very strong bath, and smaller quantities of the acids are often used. The sponge and towels should be soaked in water containing carbonate of sodium.

Diluted sulphuric acid, in conjunction with sulphate of magnesium, sulphate of sodium, and various aromatics—such as tincture of capsicum and peppermint water—is useful in lead-poisoning, by forming an insoluble salt in the intestines. This is a stock-remedy, in many hospitals, for summer diarrhœa. It is inferior to a saturated solution of camphor in alcohol; but as it is usually distributed to all comers, it probably serves a useful purpose. It is usually given in the form of a mixture, the formula for which is as follows:

Diluted Sulphuric Acid,	ʒ ij.
Tincture of Opium,	ʒ i.
Spirit of Chloroform,	ʒ jss.
Water,	to ℥ viij.

Dose, two tablespoonfuls.

It would not be difficult to improve this mixture without adding to the expense. In the first place, camphor water, or strong peppermint water, might be used instead of ordinary water, and tincture of capsicum would be a useful ingredient. The chloroform might be omitted and molasses be used as a flavoring agent.

Boric Acid, or Boracic Acid, is an antiseptic, disinfectant, and deodorant. It does not check the peptonizing action of gastric juice or of the pancreatic secretion, nor does it arrest the conversion of starch into glucose. It checks putrefactive fermentation, and prevents the conversion of alcohol into acetic acid. It produces little or no irritation of the tissues—a circumstance which renders it especially useful as a surgical dressing. The ointment is largely employed in the treatment of wounds, burns, and some skin diseases—such as eczema. As a dusting-powder it is useful in preventing the disagreeable odor arising from decomposing sweat. It rarely fails to effect a cure. It is largely used to prevent milk from turning sour. The question has arisen as to whether this addition is harmful, and it has been suggested that small doses of boric acid, taken systematically, may prove injurious; but there is no evidence that it produces any prejudicial effect on the animal economy. In large doses it would probably act as a gastro-intestinal irritant.

Boroglyceride is made by heating together ninety-two parts of glycerin and sixty-two parts of boric acid. It is said to be a definite chemical compound. Its solution in water is a powerful antiseptic, and will keep milk, fish, meat, and other articles of food, almost indefinitely.

In the treatment of flatulence, due to acid fermentation, the following mixture will be found useful:

Boroglyceride,	ʒ ss.
Glycerin,	ʒ ss.
Spirit of Chloroform,	♏ xv.
Syrup of Lemon,	ʒ ss.
Water,	to ℥ j.

Borax (the biborate of sodium) is a powerful disinfectant, quickly destroying all forms of vegetable life. It exerts a sedative effect on the mucous membrane of the throat and adjacent parts, and is used for this purpose in the forms both of the honey, and the glycerin of borax. In the stomach it plays the part of a mild alkali and, being readily absorbed, increases alkalinity of the blood.

When given in large doses, borax produces a certain train of symptoms to which the term "borism" has been applied: Intestinal disturbance, with nausea, vomiting, and anorexia, is common. Dryness of the skin, with redness and inflammation of the mucous membrane, is next noted. There is an eruption on the skin which may assume the form of seborrhoic eczema, reddish patches which desquamate, or papules attended with much itching. The hair is dry and comes off in large quantities. There is general weakness, due, partly, to the toxic effects of the drug and partly to the anorexia. In severe cases albumin may appear in the urine.

Of late borax has been used in epilepsy, and is useful in certain cases in which the bromides have little or no effect, or are badly borne. In certain cases the bromides act when borax fails, while, in another class, borax is useful where bromides fail to effect any beneficial change. Apparently borax does most good when the epilepsy is associated with gross organic disease.

It has some action as an emmenagogue and increases the contractile power of the uterus. It is eliminated by the kidneys and increases the flow of urine.

[PREPARATIONS.—Sodii Boras; Glyceritum Boroglycerinum, 31 per cent.]

Hydrocyanic Acid.—The substance used in medicine is diluted hydrocyanic acid, a colorless liquid, easily recognizable by its characteristic odor of bitter almond. As a rule it is better not to taste it. Although nominally a two per cent. solution, it varies much in strength, some specimens being as low as 0.6 and others as high as 3.2 per cent., depending on the mode of manufacture, the length of time the specimen has been kept, and the degree of exposure to light.

The leaves of the common cherry laurel (*Prunus laurocerasus*) owe their activity to the prussic acid they contain. Laurel water, obtained by distillation, is an active poison, and many deaths have occurred from its administration. It is so variable in strength that it is unsuited for administration as a medicinal agent. Essential oil of bitter almond also owes its properties to the presence of prussic acid. It, too, varies much in strength, but is usually about four times as strong as the diluted acid.

ACTION.—Prussic acid is fatal to all forms of animal and vegetable life, and even prevents decomposition and fermentation. It acts energetically as a poison by whatever channel it is introduced into the body. Whether it is swallowed, dropped into the eye, applied to wounds or cuts, or inhaled, its action is exerted with tremendous energy. People have fallen down insensible from merely smelling a bottle of the strong acid.

In man the symptoms appear very rapidly indeed, often in a few seconds. When the dose taken is less than a fatal one, giddiness, staggering, insensibility, and loss of motor power are quickly noticed, and these are succeeded by violent gasping for breath, panting respiration and, perhaps, tetanic convulsions. This spasmodic condition is due to irritation of the respiratory and so-called spasm-centres in the medulla oblongata. When a fatal dose is taken, the patient is nearly always insensible in two minutes. The poison passes rapidly into the blood and is speedily eliminated by the breath, so that if life can be maintained, even for half an hour, recovery takes place. The symptoms are similar to those of asphyxia, excepting that the blood is red, and that artificial respiration will not avert death. The cause of this asphyxia is not certain, but it is known that hydrocyanic acid forms, with hæmoglobin, a special compound which can take up oxygen, but parts with it with difficulty.

Hydrocyanic acid is a general protoplasmic poison and quickly abolishes the functions of all tissues. It paralyzes first the brain, then the cord, and finally the motor nerves and muscles. The heart stops in diastole, its arrest being due partly to the action of the poison on its ganglia and the muscular tissue, and partly to irritation of the central origin of the inhibitory fibres of the vagus and of the vasomotor nerves.

In fatal cases the symptoms usually commence in the act of swallowing (or at all events immediately afterward), and their appearance is rarely delayed beyond one or two minutes. The question is often discussed, in relation to medico-legal investigations, as to whether a person who has swallowed a fatal dose of prussic acid is capable of performing any voluntary act, and the reply is unhesitatingly in the affirmative, for, in more than one instance, the patient has attempted to reach an antidote, and has even been heard to call out loudly for hartshorn.

THERAPEUTICS.—In small, medicinal doses the diluted acid acts as a sedative to the mucous membrane of the stomach, and is not uncommonly given in conjunction with bismuth.

[PREPARATION.—Acidum Hydrocyanicum Dilutum, 2 per cent.]

AMMONIUM COMPOUNDS

That which is implied by the name ammonia is a solution of the gas in water. Such solution has a strong alkaline reaction and combines readily with acids. Being already an aqueous solution, it displays but little affinity for water, but has a high diffusion-power, and readily penetrates the cuticle, destroying the tissues with which it comes in contact and producing a slough or ulcer. Applied to the skin—say in the form of liniment—it is rubefacient and counter-irritant, especially if the application is prolonged. If a piece of cotton wool is dipped in strong ammonia, placed on the skin, and covered with a watch-glass, it acts as a vesicant, producing a blister.

When inhaled—in the form of smelling salts, for example—ammonia stimulates the mucous membrane, excites the vaso-motor centre, heightens blood-pressure, and increases rapidity of the heart's action. It is a powerful stimulant, and always strengthens the force and frequency of the heart's beat. In frogs the ammonium salts, in small doses, strengthen ventricular action; but larger quantities destroy muscular contractibility. In the stomach ammonia excites a sensation of warmth, and neutralizes any excess of acid. After large doses there is an increased secretion of mucus which may give rise to vomiting.

Ammonia is quickly absorbed and, presumably, increases alkalinity of the blood. In large doses it interferes with the respiratory function by its action on the red blood-corpuscles. When injected hypodermically in large doses, it gives rise, in animals, to convulsions and spasmodic breathing, due to irritation of the spinal cord and medulla. Its influence is transitory, for, owing to its high diffusion-power, it is speedily eliminated, partly by the lungs and partly with the urine, being partly converted into urea from contact with carbonic acid in the blood.

Aromatic Spirit of Ammonia, although nominally a preparation of the carbonate, with ammonia water, etc., owes its properties as a stimulant (and to some extent as an antispasmodic) chiefly to the free ammonia which it contains.

[PREPARATIONS.—Aqua Ammoniæ, 10 per cent. of the gas; Aqua Ammoniæ Fortior, 28 per cent. of the gas; Linimentum Ammoniæ, 35 per cent. of Aq. Ammoniæ in Cottonseed oil; Spiritus Ammoniæ Aromaticum, 9 per cent. of Aq. Ammon.]

Solution of Acetate of Ammonium is the ancient spirit of Mindererus, and was named after Minderer or Mindererus, who was the first to use it. It is a colorless fluid, and should be absolutely neutral to test-paper.

Acetate of ammonium is not a cardiac stimulant; but acts as a vascular stimulant, dilating the blood-vessels and equalizing the circulation. It prevents the congestion of internal organs which might occur as the result of exposure to cold. When the patient is kept warm it acts as a diaphoretic, promoting the action of the skin. When the body is cold and perspiration is not easily induced, it acts as a diuretic, increasing the urinary flow. In large doses it is used in the treatment of difficult menstruation, and is probably an emmenagogue.

The dose commonly recommended is from two to six drachms; but as much as four ounces may be given at a dose with safety.

Carbonate of Ammonium.—This salt has an alkaline reaction, smells strongly of ammonia, and has a high diffusion-power. When inhaled it stimulates the mucous membrane, excites the vaso-motor centre, and increases blood-pressure. By virtue of its alkalinity it stimulates the secretion of gastric juice, by which it is neutralized and decomposed. It stimulates the respiratory centre, and acts as an expectorant. In large doses it is an emetic, acting reflexly on the vomiting centre. In the lower animals, when injected under the skin or directly into the circulation, it produces convulsions accompanied by spasm of respiration, an effect due to its action on the medulla oblongata and spinal cord.

Carbonate of ammonium is one of the constituents of the ordinary smelling-salts used for cold in the head. It is frequently administered in cases of chronic bronchitis attended with difficult expectoration, and may be given in conjunction with chloride of ammonium or iodide of potassium.

[PREPARATION.—Spiritus Ammoniæ Aromaticum, 3.4 per cent.]

Chloride of ammonium or sal-ammoniac has no odor of ammonia. It is one of the salts purified by sublimation. It increases the secretions of all mucous membranes and may excite catarrh. The chlorides enter largely into the composition of mucus, and the chloride of ammonium probably acts by supplying it with one of its most important constituents. It is said to hasten nutritive changes in mucous membranes, and to favor exfoliation of epithelium. It exerts a special action on the gastric mucous membrane. Having a high diffusion-power, it passes quickly into the blood. It does not reach the intestines, and does not act as a purgative. It is not decomposed by the gastric juice, and does not act as a stimulant to the heart or influence the circulation. It is not given in syncope, nor is it used in the form of smelling-salts. It increases the formation of glycogen in the liver. It is a nerve-tonic and is largely employed in the treatment of neuralgia of the face and in sciatica. When given in large doses it usually acts promptly. It is an alterative, and is useful in rheumatism and allied affections.

Chloride of ammonium is not oxidized in the blood and is eliminated completely by the kidneys, unaltered. It increases all the constituents of the urine with exception of the uric acid, which is slightly diminished. It may be detected in the saliva.

The dose of chloride of ammonium, as an expectorant, is ten grains three times a day, and as a nervine tonic, forty grains three times a day. It is freely soluble in water, and its bitter taste is best covered by fluid-extract of liquorice.

Nascent chloride of ammonium is of much value in the treatment of chronic bronchitis and winter cough. The fumes are generated by drawing air through hydrochloric acid and water of ammonia, and allowing the products to mix. Several forms of apparatus have been devised for this purpose. It is important that the fumes should contain no free or uncombined acid ; but it is still more important that they should contain no free ammonia, which acts as a powerful irritant to the glottis. I find it a good plan to put a few drops of acetic acid in the wash-bottle, so as to neutralize any excess of ammonia. The water may be colored with a little tincture of litmus, which indicates at a glance the presence of any uncombined alkali. The mouthpiece should be furnished with a long piece of india-rubber tubing, so that the patient may sit back in his chair and inhale in comfort. The fumes should be taken well into the chest, and not merely into the mouth. It is often desirable to medicate the fumes in various ways by adding a few drops of terebene, pinol, or oil of eucalyptus to the water in the wash-bottle.

The chloride of ammonium lozenges of the Pharmacopœia contain two grains each. Sucked frequently, they are useful in the early stage of bronchial catarrh.

The following is a useful formula for bronchial catarrh and the early stage of chronic bronchitis :

Chloride of Ammonium,	ℨ ij
Fluid-extract of Liquorice,	ℨ iij.
Syrup of Wild-cherry,	℥ ij.
Syrup of Ipecacuanha,	ℨ iij.
Water,	℥ iij.

A teaspoonful every three or four hours.

Taking it all round, chloride of ammonium is one of the most useful remedies at our disposal.

POTASSIUM COMPOUNDS

Potassium—speaking now of the base generally—is a protoplasmic poison which destroys all structures with which it is brought in contact in a sufficiently concentrated form—muscle, nerve, and nerve-centres especially. In small doses it increases the contractile power of muscular tissue, but in large doses it abolishes it entirely. It induces spasmodic contraction of the muscular tissue of the frog's heart, followed by paralysis. Potassium is a far more powerful paralyzer than either sodium or ammonium, and this is the explanation of the preference displayed by many prescribers for iodide and bromide of sodium over the corresponding potassium salts.

Potash, as an alkali, has high diffusion-power, and a strong affinity for water. It dissolves nitrogenous tissues. In the stomach it increases the secretion of gostric juice, and it is absorbed into the circulation and converted into a carbonate. It increases the disintegration of the nitrogenous tissues.

Potassium salts act on the circulation somewhat like digitalis. After administration of large doses the symptoms noticed are muscular weakness with dyspnœa and convulsions.

When a salt of potassium is administered to frogs, the symptoms first noticed are loss of sensation and of voluntary and reflex action, although considerable voluntary power remains, so that the animal, without sensation and without reflex action, still hops vigorously. The mode of action of potassium salts is easily explained. They paralyze all nitrogenous tissues. They have an equal affinity for all protoplasms, and destroy the tissues in the order of their vital endowment. They arrest the heart—not from any specific action on that organ, but owing to their common action on protoplasm. By arresting circulation they depress the reflex action of the cord, and impair the functions of the brain.

Both potash and soda increase the excretion of uric acid. Potash renders the urine less acid or even alkaline. The amount of acid excreted with the urine is increased; but, being neutralized by the base, it produces no acid reaction.

The action of alkalies and of acids on the secretions is easily remembered : Alkalies increase acid secretions and decrease alkaline secretions. Acids increase alkaline secretions and decrease acid secretions. In other words, an alkali or an acid checks the formation of a secretion of its own reaction.

[PREPARATIONS.—Potassa cum Calce; Potassa Sulphurata; Liquor Potassæ, 5.84 per cent.]

Bicarbonate of Potassium has the usual physiological action of alkalies. In the stomach it increases secretion of gastric juice. It is readily absorbed, and probably promotes alkalinity of the blood. It is eliminated by the kidneys, rendering the urine alkaline.

Chlorate of Potassium.—There is much difference of opinion respecting the value of chlorate of potassium as a remedial agent. It came late into therapeutic consideration as compared with many other potassium salts. Lauded at first as an almost universal panacea, it was quickly consigned to the *limbo* of dangerous or doubtful drugs, and finally came to be regarded as useless excepting as a purely topical medicament. It was originally employed on the theory that it yields oxygen to the system in diseases in which the blood was supposed to be deficient in that element. When it was discovered that it was eliminated unchanged in the urine, this theory had to be abandoned, and those who were formerly most enthusiastic in its praise ceased to employ it.

ACTION.—Chlorate of potassium increases the flow of saliva—which becomes distinctly acid—and, if its use is long continued, may produce ulceration of the mucous membrane of the mouth. Its beneficial effect in many throat affections is due to a local antiseptic action. A small quantity of chloric acid is set free from the base, and this nascent chloric acid acts as a disinfectant.

Chlorate of potassium passes rapidly into the circulation. In the blood it converts the hæmoglobin into methæmoglobin, the blood assuming a chocolate color and losing its power of parting with oxygen. The corpuscles swell up and relinquish their coloring matter to the liquor sanguinis. There is no evidence that the salt is decomposed, or that it gives up its oxygen.

The urine is blood-stained, and contains casts plugged with coagulated blood. The salt is eliminated unaltered, and may be detected in the secretions of the mouth.

Small doses at first depress, and afterward raise the blood-pressure and accelerate the pulse. Large doses may arrest the respiratory function and lower blood-pressure without materially affecting the heart. Large doses greatly improve the appetite, but may induce inflammation of the mucous membrane of the stomach and give rise to vomiting and purging.

The THERAPEUTICAL use of chlorate of potassium is chiefly in the treatment of affections of the mouth, gums, throat, and adjacent parts. It is useful in salivation, in ulcerative stomatitis, and in follicular and phagedenic ulcerations. A saturated solution of the salt in water forms a good gargle. Dr. Lloyd Roberts, of Manchester, finds that the lotion is useful in the teasing dryness of the mucous membrane of the throat left after diphtheria.

For internal administration chlorate of potassium is best given either in milk or with some aërated water. It would be safe to give from a drachm to two drachms three times a day, but death has resulted from a single dose of six hundred grains, and from doses of three hundred, administered on four successive days.[1]

[PREPARATION.—Trochisci Potassii Chloratis, 5 grs.]

Bitartrate of Potassium.—This substance is commonly known as acid tartrate of potassium or cream of tartar. It has a low diffusion-power, so that very little passes from the stomach into the blood. It stimulates the mucous membrane (chiefly of the small intestine) to increased secretion, and this is not merely the result of irritation or osmosis, but is a true secretion. There is likewise an excretion by the membrane of urea and of other waste products. There is no increase of peristalsis; but when acid tartrate of potassium is combined with a drug which has this property, it acts as a powerful hydragogue purgative.

When the dose is too small to excite purgation, the drug is absorbed from the intestines and passes into the blood, where it is converted into a carbonate, and acts as a diuretic, increasing the secretion of urine and rendering it less acid or even alkaline.

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[1] [See "The Remedial and Fatal Effects of Chlorate of Potassa," by A. JACOBI, in the Medical Record: 1879, xv., 241–244.]

Cream of tartar is often prescribed in the form of the haustus imperialis or imperial drink, which is largely used for febrile patients. The formula is :

Bitartrate of Potassium,	ʒ i.
White Sugar,	ʒ iv.
Boiling Water,	Oj.

[PREPARATION.—Pulvis Jalapæ Compositus, Jalap, 35 parts; Pot. Bitart., 65 parts.]

Permanganate of Potassium.—This salt is met with in the form of purple, acicular crystals, which are readily soluble in water and have a sweet, astringent taste. It is decomposed by alcohol, and is a powerful oxidizer, giving off oxygen so readily that if mixed with any organic or readily oxidizable substance, such as sugar, syrup, or glycerin, the mixture catches fire, or may even explode spontaneously. Its power of destroying organic matter is also shown by rendering cobra-poison inert.

Permanganate of potassium yields ozone [when treated with barium dioxide and sulphuric acid], and is largely used as a disinfectant and deodorizer, although its sphere of action is limited.

THERAPEUTICS.—It should be administered after meals, and be followed by a tumbler of water, or it will irritate the stomach and œsophagus and cause a good deal of pain.

It is used with much success in the treatment of amenorrhœa, but its mode of action is uncertain. The dose, in such cases, is from one to two grains, three times a day. A solution is too nasty to take, and the drug must be given either as a pill or tablet. If the pills are made up with a fatty substance, and taken on an empty stomach, they produce much gastric disturbance attended with pain and vomiting. If, however, they are made up with kaolin (porcelain clay), and given immediately after meals, they are perfectly safe. Some physicians seem to be afraid to prescribe them, and always order binoxide of manganese instead, which is non-irritating and, in doses of two grains, is almost equally efficacious in establishing the menstrual flow.

Recently it has been introduced as an antidote in cases of poisoning by opium and morphine. It has long been known that morphine is readily oxidized by the permanganate, the latter being reduced to hydrated manganese dioxide. It is stated, on the authority of Dr. William Moore, of New York, that the oxidization of morphine renders it perfectly innocuous, depriving it entirely of its toxic properties. It was thought that the presence of albumen in the stomach would prevent this reaction, but it was found that the permanganate reduces sulphate of morphine infinitely more rapidly than it does albuminous matter; exhibiting a peculiar, selective affinity for the morphine, as is demonstrated by a very simple experiment:

A solution is made containing two hundred and fifty grains of white of egg and one grain of sulphate of morphine, in an ounce of water. To this is added one grain of permanganate of potassium, also dissolved in an ounce of water. After rapidly mixing the solutions not the slightest trace of morphine can be detected. It appears that a grain of the permanganate exactly oxidizes one grain of morphine; but it is better, as a matter of precaution, to take a grain more than the quantity of permanganate absolutely necessary to neutralize the alkaloid. Dr. Moore—who states that he is extremely susceptible to the action of narcotics—made some experiments on himself which are of much interest. On the first occasion, after a light supper, he took three grains of sulphate of morphine followed, half a minute later, by four grains of potassium permanganate dissolved in water. He experienced no ill effects, although, from his peculiar susceptibility to the drug, he would have been affected had even an eighth of a grain of morphine been absorbed. On another occasion he took, two hours after breakfast, five grains of sulphate of morphine in an ounce of water, followed almost immediately by eight grains of the antidote, dissolved in eight ounces of water.

In cases of poisoning by any of the *salts of morphine*, from eight to ten grains of the permanganate should be dissolved in a pint of water and administered at once, the dose being repeated once or twice at intervals of half an hour. This treatment promises well, and is likely to be largely employed, especially from the fact that the permanganate, from its use as a disinfectant, is found in many households, or can be obtained at a moment's notice. Condy's Fluid is a two per cent. solution, so that an ounce of this in a pint of water would be practically the correct dose.

In cases of poisoning by *morphine itself* (not its salts), or by *opium* or its preparations, it would be advisable to add a couple of teaspoonfuls of white vinegar to the antidote, so as to convert the morphine into a soluble salt. When the patient is insensible, the antidote may be introduced by the stomach-pump, or, better still, by a piece of rubber tubing passed through a nostril into the stomach. The tube, furnished at its free extremity with a glass funnel, can be readily filled, and, by depressing its extremity, can be made to act as a siphon, so as to wash out the stomach every few minutes. As morphine after being absorbed is again eliminated by the mucous membrane of the stomach, it would be well to give a weak solution of the antidote—say a grain in a tumblerful of water—hourly for some hours, even when all the opium or morphine is supposed to have been rendered inert.

Permanganate of potassium exhibits a similar selective affinity for eserine in the presence of albumen. On the other hand, it exerts no oxidizing effect on atropine, hyoscyamine, hyoscine, cocaine, aconitine, veratrine, pilocarpine, muscarine, caffeine, or phosphorus. Moreover, it gives up its oxygen much more quickly to albuminous matter than to strychnine, oxalic acid, colchicum, or hydrocyanic acid. It is thus apparently an antidote for opium, morphine, physostigma, and eserine; but not, so far as we know, for other poisons.

SODIUM COMPOUNDS

[**Soda,** sodium hydrate or caustic soda, is not used internally. Its official preparations are: Liquor Sodæ, 4.1 per cent.; Liquor Sodæ Chloratæ, 2.6 per cent. of chlorine.]

Bicarbonate of Sodium has the ordinary action of alkalies in checking alkaline and increasing acid secretions. If given before meals, it augments the flow of gastric juice. It passes readily from the stomach into the circulation, and increases the alkalinity of the blood. It is eliminated by the kidneys, and renders the urine less acid and even alkaline. The effervescing solution of soda is sometimes called soda-water; but the ordinarily accepted soda-water of commerce is simply a solution of carbonic acid in water charged under pressure.

[PREPARATIONS.—Mistura Rhei et Sodæ; Trochisci Sodii Bicarbonatis, 3 grains.]

Sulphate of Sodium, or Glauber's salt, is a purgative which produces watery motions.

The common saline purgatives are: Sulphate of sodium, sulphate of magnesium (Epsom salt), sulphate of potassium, phosphate of sodium, tartrate and bitartrate of potassium, tartrate of potassium and sodium (Rochelle salt), citrate of potassium, citrate of sodium, and citrate of magnesium.

The essential character of a saline cathartic, which enables it to act so much more powerfully than a non-purgative salt, seems to be the possession of the peculiarity of bitterness. A bitter substance in the mouth stimulates the flow of saliva, and it is probable that a bitter substance in the intestines stimulates the flow of the succus entericus. The property of slow-diffusibility is an important one, for whilst the bitterness promotes the secretion, the slowness of diffusion prevents absorption of the fluid.

Matthew Hay has investigated the action of saline purgatives—sulphate of sodium especially—on rabbits, cats, and dogs. Sulphate of sodium excites an active secretion in the intestines, probably, for the most part, in the small intestine, the excito-secretory influence of the salt being due partly to its bitterness, partly to its irritant and specific property, and not to osmosis. The secretion is, in the main, a true succus entericus, but the liver and pancreas also participate in the action. The low-diffusibility of the salt impedes absorption of the fluid, so that between stimulated secretion on the one hand, and impeded absorption on the other, there is an accumulation of fluid in the canal. This fluid, partly from ordinary dynamical principles, and partly from gentle stimulation of peristaltic movements excited by distension, wends its way along the intestine until it reaches the rectum and produces purgation. As the intestinal secretion excited by the salt contains very little organic, as compared with inorganic matter, this purgative action removes from the blood more of the latter than of the former.

The action of these drugs depends, to some extent, on the strength of the solution employed. Thus one drachm of a purgative salt, well diluted with water so as to form a 2½ per cent. solution, produced active purgation in a rabbit, whilst twice that dose, administered in the form of a 20 per cent. solution, produced no effect when administered to a rabbit which had been for some days on a water-restricted diet. As a rule, the more dilute the solution the more prompt the effect. Sulphate of sodium will not produce catharsis if given in a concentrated form and when little or no water is taken with the food for some hours previously. In addition to being a powerful intestinal stimulant it is also a powerful hepatic stimulant. This is of much importance in the selection of a purgative water. It has been found by analysis that in 16 Troy ounces there are, in Carlsbad water (Sprudel), 19.9 grains of sulphate of sodium; in Friedrichshall water, 46.5 grains, and in Hunyadi Janos water, from 122 to 173 grains. The Hunyadi Janos is clearly the best hepatic stimulant.[1]

When injected into the blood, sulphate of sodium excites no intestinal secretion, and does not act as a purgative. It has no toxic action. The normal constituents of the urine are not affected in quantity by the salt.

Hunyadi Janos water, taken in the morning before breakfast, is an excellent laxative. It should be mixed with an equal quantity of boiling water and sipped slowly whilst dressing. Its bitterness is by no means disagreeable, and many people soon acquire a liking for it. Its great advantage is the promptness of its action. There is one complete evacuation of the bowels without griping or straining, and there is no further trouble during the rest of the day. It stimulates the liver to action, and improves not only the appetite but the digestive powers. The dose can be regulated to a nicety and, when once the action is established, there need be no fear of any loss of effect.

It is admirably adapted to the requirements of middle-aged men who lead a sedentary life and are precluded by the nature of their occupations from taking much active exercise.

CALCIUM COMPOUNDS

Carbonate of Calcium or lime is of considerable interest to the pharmacologist. Having but little diffusion-power, its action on the skin is slight. In the form of caustic-lime it withdraws water from the tissues and, to some extent, destroys them, although only superficially. Lime-water, or carbonate of lime, applied to the abraded skin, is astringent and checks excessive discharges, probably by combining with albumin.

Lime neutralizes any excess of acid in the stomach or intestines. It is but slowly absorbed, and passes into the

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[[1] "Apenta water," from the Uj Hunyadi springs, in Budapest, whence the Hunyadi Janos comes, has recently been introduced, and is reputed to contain about 130 grains of sulphate of sodium in each 16 ounces of the water.]

blood only in small quantities, although sufficient is taken up to promote nutritional changes. It is an essential constituent of both hard and soft tissues of the body, including the muscles, nerves, and bones. Wherever there is active growth, lime salts are present in excess.

Lime exerts a digitalis-action on the heart. When the proportion of lime present is deficient the contractions are weak, but when the quantity is increased they become powerful. It is eliminated by the intestines and, to some extent, by the kidneys, for the urine becomes alkaline when it is administered.

Chloride of Calcium is frequently given in phthisis and in the wasting diseases of children, administered in doses of from twenty to thirty grains three times a day. It is freely soluble in water, and the solution may be flavored with glycerin.

[PREPARATIONS.—Liquor Calcis, 17 per cent.; Linimentum Calcis, 50 per cent. each of Liq. Cal. and Linseed Oil.]

MAGNESIUM COMPOUNDS

The term magnesia may be taken to include magnesia ponderosa or heavy magnesia, and magnesia, sometimes called light calcined magnesia. The two varieties differ only in their consistence, light magnesia being three and a half times as bulky as the heavy form.

Magnesia, when introduced into the stomach, acts as a direct antacid, neutralizing the acid with which it comes in contact. Some of it is converted into a chloride; but it has a low diffusion-power, and but little of it is taken into the circulation. The greater part passes along the intestines unaltered. The chloride, thus formed, is probably decomposed by bile in the intestines, and converted into an oxide. This, by the action of carbonic acid, becomes first a carbonate and then a bicarbonate, which acts as a laxative and slight aperient.

When magnesia is taken in large quantities there is a risk of its forming concretions in the intestines. It is eliminated chiefly with the fæces; but a portion is absorbed, and combines with uric acid and urates, rendering the urine alkaline.

[PREPARATION.—Pulvis Rhei Composita, 65 per cent.]

Sulphate of Magnesium.—The action of this useful medicine, commonly known as Epsom salt, is, in some respects, similar to that of sulphate of sodium. It is a more active purgative, a property attributable, probably, to its greater degree of bitterness. It only slightly stimulates peristaltic action of the intestine, so that, if given alone, a portion of the fluid secreted may be reabsorbed.

Rutherford has shown that it is not a hepatic stimulant, and that, in purgative doses, it diminishes the secretion of bile. In this respect it differs markedly from sulphate of sodium. The best aperient saline-water is, therefore, that which contains the largest percentage of sulphate of sodium.

In the "black-draught" sulphate of magnesium is combined with senna, which, by stimulating the muscular coat of the bowel, increases its purgative action.

When injected into the circulation, it acts as a powerful toxic agent, paralyzing first respiration, and then the heart. It abolishes sensation, and paralyzes the sensory-motor reflex-centres.

When absorbed. it acts as a diuretic if the surface of the body is exposed, but as a feeble diaphoretic if the patient is kept warm.

The bitter taste of Epsom salt may, to some extent, be covered by the addition of coffee or syrup of coffee to the solution; but possibly this addition may impair its usefulness as a purgative.

The effervescent sulphate of magnesium, or effervescent Epsom salt, though unofficial, is a useful preparation, and forms a pleasant saline purgative.

[PREPARATION.—Infusum Sennæ Compositum, 12 per cent.]

ALUM

There are several kinds of alum, potash-alum, a sulphate of aluminum and potassium, being the only one which is official in the United States. Dried-alum is a potash-alum deprived of its water of crystallization. There is no preparation for internal administration, but glycerin of alum, a solution of alum in glycerin, [is official in the British Pharmacopœia, and] is used as a local application.

Alum is employed chiefly as a topical astringent. It precipitates albumen and gelatin, and acts as an astringent, in virtue of its capacity to unite with and coagulate albumin. When applied to the unbroken skin it exerts no effect; but when it comes in contact with the albumin of pus, mucus, or of the tissues themselves, it forms an impermeable layer and protects the parts from air. In addition to its protective action it is a styptic, arresting the flow of blood from abraded surfaces or ruptured blood-vessels.

Dried-alum abstracts water from the tissues and is a slight caustic. The part should be wiped dry, so that the alum may exert its full action.

Alum possesses some power as an antiseptic. It exerts a bracing or astringent action, as, for example, when used in the form of a gargle in relaxed sore throat.[1]

In the stomach, alum coagulates the albumin, constringes the mucous membrane, and arrests the digestive process. It is an emetic, acting topically, that is to say, reflexly on the vomiting-centre. In large doses it may give rise to gastro-enteritis. It checks secretion from the mucous membrane of the intestine, and, by rendering the fæces harder and more difficult of expulsion, causes constipation. It is absorbed from the stomach and intestine, but only in small quantities. There is no evidence that it exerts any astringent action on the lungs, kidneys, or other organs, although it is frequently prescribed in the treatment of the night-sweating of phthisis. It is eliminated with the fæces, which it renders odorless.

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[1] [According to Professor Abbott, of the New York College of Dentistry, use of alum in the mouth is apt to render teeth very brittle.]

Alum was at one time largely employed as an adulterant for bread, being used to give a whiter color to the flour. It produced indigestion and constipation, and lessened the nutritive value of the bread by combining with the phosphoric acid [of the phosphates] and rendering it insoluble. It is probable that alum is not so largely used by bakers as formerly; but as much as forty grains have been detected in a four-pound loaf.

[PREPARATION.—Alumen Exsiccatum.]

ZINC COMPOUNDS

Oxide of Zinc is a sedative to the skin and, mixed with starch, is frequently used as a dusting-powder. The only preparation of the oxide is the ointment made with benzoated lard.

The oxide is but slightly soluble in gastric juice unless much acid is present ; but some of it must be absorbed, as evidenced by its astringent effect, especially in checking night-sweating of phthisis, for which it has been so long used that the origin of the treatment is lost in obscurity.

As far back as 1837, Dr. Busse, of Berlin, recorded the case of a man who, after taking twenty grains of the drug daily for some months, for epilepsy, became cold and shrivelled and his skin like parchment. Some years later Dr. Robert Dickson, of the Hospital for Consumption, at Brompton, again noticed its property of drying the skin in the case of patients to whom he administered the drug as a general tonic and for diarrhœa, and this induced him to give it with a view of checking nocturnal perspirations. The treatment was alluded to in a lecture delivered by Dr. Theophilus Thompson, in 1851, since when it has been very generally employed, although it has, to some extent, been superseded by more recent introductions.

The oxide does not produce emesis. Its other actions are identical with those of the sulphate.

Calamine, an impure oxide, or a mixture of oxide and carbonate, is employed for the same purpose, especially in the form of a lotion.

The following is a useful application for the face. It is cooling, and affords great relief in cases of eczema and acne:

Calamine,	ʒ vi.
Oxide of Zinc,	ʒ iij.
Glycerin,	℥ ss.
Elderflower Water,	℥ iv.
Rose Water,	to O ss.

The lotion is to be dabbed on the face with a small sponge and allowed to dry, superfluous powder being dusted off with a soft pocket-handkerchief.

In cases of nasal catarrh, coryza, and polypus, the following powder is excellent :

Dermatol,	ʒ iv.
Calamine,	ʒ iv.
Oxide of Zinc,	ʒ iv.
Boric Acid,	to ℥ ij.

The ingredients should be finely powdered and intimately mixed. It should be used three or four times a day with an insufflator.

The ordinary dusting powder consists of one part of oxide of zinc and two of powdered starch.

Dermatol is not official. It is a basic gallate of bismuth, and, in addition to being an astringent, is an antiseptic.

Oxide of zinc pills, used for checking the sweating of phthisis, contain two and a half grains in each, and are made with extract of liquorice. Extract of belladonna is often added, but there seems to be no object in employing two active drugs when one will do. Two pills at bedtime will check the sweating.

[PREPARATION.—Unguentum Zinci Oxidi, 20 per cent.]

Sulphate of Zinc is met with in the form of small, acicular crystals, almost identical in shape with those of sulphate of magnesium. It is slightly efflorescent, and freely soluble in water. When applied to abraded skin, it coagulates albumin and contracts the blood-vessels. It is an astringent when applied to mucous membranes, and lessens discharges.

Sulphate of zinc acts as a speedy emetic, producing rapid evacuation of the stomach. This action is due partly to the topical effect on the stomach, and partly to stimulation of the vomiting-centre in the medulla-oblongata after absorption. It acts equally well as an emetic when injected into the circulation. Its action in this case must be chiefly on the vomiting-centre, but probably some of the drug is excreted by the mucous membrane of the stomach and acts locally.

Zinc is not deposited in the tissues in the same manner or, at all events, for so long a period, as mercury, lead, or copper. It is eliminated partly with the urine and partly with the fæces. It is probable that much of the sulphate is absorbed by the stomach, and then eliminated by the mucous membrane of the intestine, and with the bile.

THERAPEUTICS.—Sulphate of zinc, after absorption, acts as a nerve-tonic, and is largely employed in many affections of the nervous system. Tolerance is soon established, and large doses—as much as forty grains three times a day—may be taken without inducing nausea or vomiting. It is used in diarrhœa ; but its astringent effect must be exerted chiefly on the upper part of the intestine, for in its progress through the intestinal tract it is soon converted into an insoluble sulphide.

The prolonged use of medicinal doses of the zinc-salts may induce a condition similar to chronic saturnism. Zinc colic, analogous to lead colic, sometimes occurs. The chief symptoms are constipation, vomiting, prostration, and a metallic taste in the mouth. There is a malady known as "brassworkers' disease" ; but it is not clear whether the symptoms are due to zinc or copper, both of which enter into the composition of brass.

The dose of sulphate of zinc, as an emetic, is twenty or thirty grains; and a good formula for an emetic draught is: Sulphate of zinc, thirty grains; powdered ipecacuanha, fifty grains; To be taken in water. It is far less active than apomorphine.

Sulphate of zinc, in two-grain doses, will check the night-sweating of phthisis; but the oxide is usually employed for this purpose.

The ordinary red-wash, employed in some hospitals as a dressing for wounds and indolent ulcers, is composed of sulphate of zinc, twenty grains; compound tincture of lavender, two drachms, and water, to half a pint.

SULPHATE OF COPPER

This salt is commonly known as blue stone, or blue vitriol.[1] It is in the form of large, azure-blue crystals, which have a styptic taste, are slightly efflorescent, and dissolve freely in water. It is astringent; when applied to denuded surfaces it coagulates albumin, constringes the blood-vessels, and covers the part with a pellicle which protects it from contact with air. If the application is a strong one, it may act as an irritant and produce pain and smarting. It is a mild caustic.

In the mouth it combines with albumin, precipitating it more or less completely. Given by the stomach, it acts as an emetic, producing one copious evacuation unattended with much nausea. It exerts its action partly on the stomach and partly on the vomiting-centre. It acts equally well when injected into the circulation, acting directly on the vomiting-centre, and also on the stomach, by the mucous membrane of which it is partly eliminated. It is absorbed from the stomach, and exerts a tonic and astringent action on the tissues. It promotes assimilation and acts as a tonic. It is excreted by the kidneys, and also by the intestines, appearing in the fæces, which it turns black.

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[1] Sulphate of iron is called "green vitriol," whilst sulphate of zinc is "white vitriol," and the popular name for sulphuric acid is "oil of vitriol."

If taken for some time it produces colic with alternate constipation and diarrhœa. It may cause paralysis of the extensor muscles of the arms.

People who work in copper mines are liable to a peculiar, greenish coloration of the hair. The beard and moustache are first affected, and then the hair of the scalp. Copper can be detected in the hair chemically, and under a microscope the coloration is seen to be uniformly distributed.

Sulphate of copper is prescribed in cases of obstinate diarrhœa—such as that of phthisis or of enteric fever. The dose should not exceed a quarter of a grain, and it may be given in a pill with a quarter of a grain of extract of opium. At one time copper salts were used in the treatment of chorea, epilepsy, and other diseases of nervous origin; but of late they have given place to other and better remedies.

Copper is frequently used to color canned peas and other vegetables, and often in such quantities as to be distinctly prejudicial to the consumer.

NITRATE OF SILVER

Nitrate of silver, when applied to the skin, acts as a caustic; but it has little power of penetration and cannot destroy the tissues to any depth. Upon the denuded skin it forms a protective film or covering, contracts the superficial blood-vessels, and acts as a local astringent. In the mouth, it exerts an astringent action, and is converted into an albuminate. In the stomach, it acts as an irritant, unless there is sufficient albumen present to arrest its action.

It is absorbed into the blood, partly from the stomach and partly from the intestines, in the form of a double chloride and albuminate.

It is eliminated slowly, so that if administered continuously it may produce the conditions to which the term argyria is applied. The gums show the earliest indication of this condition by a blue line, which is darker than that which is produced by lead. Next, the lanulæ of the nails, the eyeballs, and the skin of the face and hands are affected. This discoloration, which is increased by exposure to light until the skin becomes almost black, is permanent and persists for life. On microscopical examination, dark granules of the metal are found in the cuticle, walls of the sweat-glands, hair follicles, the sarcolemma and neurilemma, middle-coat of the arteries and veins, the cerebral and spinal membranes, the laryngeal and bronchial membranes, the peritoneum, and in other parts. The discoloration is due to a deposit of the metal in a very finely-divided state. If the administration of the drug is stopped on the appearance of the first symptoms, no further blackening occurs.

The quantity required to produce this condition is not known; but probably less than an ounce, extending over a period of some three or four months, would suffice. It would be safe to give the drug in ordinary doses, without intermission, for six to eight weeks. This condition has been known to follow its local application, as in the case of a girl whose throat was repeatedly cauterized with nitrate of silver, resulting in the production of all these symptoms.

Long-continued administration may also cause loss of appetite, impaired nutrition, and rapid, irregular action of the heart. Post-mortem, there is found fatty degeneration of the heart, liver, and lungs.

In the lower animals, nitrate of silver excites convulsions, followed by paralysis of central origin, the convulsions being similar to those produced by strychnine. In fatal cases death is due to asphyxia, and the lungs are found congested, owing to the bronchial tubes being choked with mucus.

Nitrate of silver is eliminated by the liver and intestines, very little escaping with the urine.

MERCURY AND ITS COMPOUNDS

Metallic mercury, in the liquid state, is rarely used in medicine, but in former times it was employed as a solvent for silver coins accidentally swallowed; for its mechanical effect in the treatment of obstruction of the bowels and constipation, and to beautify the complexion and remove freckles. In the reign of Charles II. quicksilver was taken by the ladies of the Court in doses of a teaspoonful night and morning.

ACTION.—Large quantities of metallic mercury—a pound or more at a time—have been taken without the production of any symptoms; but should a portion become oxidized, the constitutional effects of the drug would be speedily produced. The blue-pill and gray-powder are active from their state of minute subdivision.

The salts of mercury possess various physical as well as chemical properties; but as their pharmacological action is practically identical, it is clear that they all ultimately assume the same form in the blood.

Mercury, when applied topically to the skin in the form of an ointment or plaster, is absorbed, passing through the epidermis without exciting inflammation. The *mercurous* salts are absorbed in the same way, and although they are more stimulating, they give rise to no irritation. The *mercuric* salts have little action on the epidermis, but when applied to the denuded skin they precipitate albumin, and, if used in a concentrated form, may act as caustics and produce a slough. When taken internally, they cause symptoms of gastro-enteritis from their local action.

In the stomach, mercury combines with albumen to form an albuminate of mercury, which is not soluble in water, but is readily soluble in excess of albumen and in chloride of sodium. It is absorbed in the form of a compound of mercuric oxide with albumen.

It has always been supposed that calomel increases the secretion of bile, and yet Rutherford's experiments on healthy dogs show that this is not the case. On the other hand, bichloride of mercury acts as a hepatic stimulant in a very marked degree. It is possible that some of the calomel may, by the action of the gastric juice, be converted into corrosive sublimate, yet five grains of calomel subjected for seventeen hours, at a temperature of 100° F., to the action of dilute hydrochloric acid, of the same strength as human gastric juice, yielded only $\frac{1}{35}$ grain of the bichloride. It seems more than probable that the physiological observations are right, and that the so-called clinical experience has, in this instance at least, singularly failed.

When mercury is absorbed into the circulation, either from the skin or the stomach, it produces a train of symptoms to which we apply the term mercurialism or hydrargyrism. These symptoms are as follows :

There is a disagreeable, metallic taste in the mouth. The gums become swollen, tender, and assume a dark-red color. The teeth feel sticky, as though their edges were glued together. The tongue swells and is covered with a thick fur, and the breath is foul. Ptyalism or salivation ensues, the secretion of saliva being increased even to the extent of one or two pints in twenty-four hours. This salivation is due partly to reflex excitement of the glands by irritation of the tongue, and partly to stimulation of the nerves of the glands and of the gland-structure itself. The glands are swollen and tender, and the saliva is at first richer than natural in epithelium and solid constituents, but after a time becomes clear and more watery.

Stomatitis or ulceration of the mucous membrane of the mouth comes next, and is often very extensive. Large portions of the cheek and gums slough, the teeth fall out, and the jaw becomes carious. An eczematous rash appears on the skin. Periostitis is not uncommon. Mercurial erethism, a low, febrile condition accompanied by intense prostration, next ensues.

Profound anæmia and marasmus or wasting, accompanied by excessive purging, follow, the motions being frequent and containing much bile. Neuralgic pains in the limbs, mercurial tremor, paralysis, and epileptiform convulsions are common toward the end.

Many of these symptoms are similar to those produced by syphilis. It is not to be supposed that they all occur in every case. Some people are much more readily affected than others. Ptyalism has been known to follow the administration of a grain and a half of calomel, or of an eightieth of a grain of corrosive sublimate. Scrofulous patients, and people suffering from disease of the kidneys, are very susceptible to the action of mercury. Children take it well, and are not easily salivated.

When mercury is inhaled in small quantities for a length of time, as in the case of workers in quicksilver mines, barometer and thermometer makers, water-gilders (who plate with gold dissolved in mercury), and looking-glass manufacturers, a somewhat different train of symptoms ensues:

The body wastes, the sufferer becomes weak and anæmic, "mercurial fever" ensues, accompanied by a vesicular or pustular eruption. There are tremors, commonly known as "shaking palsy" or "the trembles." Weakness usually appears first in the upper extremities; the voluntary movements lack their usual precision; slight tremors set in, and gradually increase both in severity and extent until the whole body is affected, the legs suffering before the trunk. The tremors are easily excited, are uncontrollable, and persist for some time. The tremulous hand can no longer be directed with precision and, after a time, can scarcely convey food to the mouth. An old doctor describing the case of one of his patients says: "He could not with both his hands carry a glass half full of wine to his mouth without spilling it, though he loved it too well to throw it away." After a time the legs are affected and begin to shake, especially at the knees, so that in walking they tremble and dance about as if hung on wires.

There is loss of memory, which may be followed by headache, convulsions, and delirium. Speech is hurried, staccato, and stammering, and in extreme cases there is disturbance of the intellect. The skin is dry, and assumes a peculiar, brownish color.

When the disease attains its greatest intensity the unfortunate sufferer presents a most pitiable aspect. In constant, tremulous commotion; tottering, trembling, shaking, and stuttering, he is almost helpless. He can hardly walk or talk, he dare not touch any object for fear of breaking it or letting it fall, and on raising his agitated hand with food to his mouth, he misses his aim and inflicts involuntary blows on his face. He must be fed and clothed like a child. Some unfortunates, deprived of assistance, have been known to crawl on all fours, and seize their food with the lips, like the lower animals.

In its early stage the complaint may be mistaken for paralysis agitans or chorea, and, as the end approaches, for delirium tremens.

This complaint is not so common as it was formerly, and of late years the cases have become much less common, water-gilding having been to a great extent superseded by electroplating. Looking-glass-silvering is now carried on in large, well-ventilated rooms provided with special means for preventing the diffusion of metallic particles, and the men are employed only at intervals. In times past, however, cases were of constant occurrence. A few years ago an English man-of-war received on board several tons of quicksilver saved from the wreck of a vessel near Cadiz. In consequence of the rotting of the bags, the mercury escaped, and the whole of the crew became more or less affected. In the space of three weeks two hundred men were sickened by it, two died, and all the animals—cats, dogs, sheep, fowls, a canary bird, and even the rats, mice, and cockroaches—were destroyed. Early in this century there occurred another instance, on a still larger scale, of poisoning by mercurial vapor. A fire broke out in the quicksilver mines at Idria, near Trieste, and above nine hundred persons in the neighborhood were attacked with the "trembles."

When given in small doses the corrosive chloride increases the formation of blood-corpuscles, but in large doses it diminishes their number. It is an alterative, and has the power of causing absorption of fibrinous exudations. It lessens the force of the pulse, and, when applied to a frog's heart, arrests its action.

Mercury is excreted with the saliva, bile, urine, sweat, and milk.

THERAPEUTICS.—Mercury is largely employed in the treatment of syphilis, the "small dose" method being the best. The formula employed is one grain each of gray-powder and Dover's-powder, in pill or tablet, of which one may be given four times a day. There is, practically, no risk of ptyalism, and the treatment may be kept up for weeks or even months. The addition of Dover's-powder prevents diarrhœa. The patient may go about his work as usual, and there is no risk of catching cold. During a mercurial course fruit, green vegetables, coffee, and aperients of all kinds, should be avoided. Stimulants should be taken in the smallest quantities, and the patient should give up smoking or he will get a sore throat and mucous patches about the mouth. Some people prefer the green iodide of mercury in doses of a sixteenth of a grain.

Calomel is a useful purgative, and three grains at bed-time, made into a pill with extract of hyoscyamus, will usually open the bowels freely. It is a custom in many [British?] hospitals to give every patient, on admission, ten grains of calomel; but this seems an unnecessarily active mode of treatment. When a well-marked action on the liver is required, without violent purging, a pill containing one grain of calomel and one of euonymin will be found useful, and may be repeated at intervals during the day. A pill containing half a grain of gray-powder answers equally well if repeated every three or four hours.

The corrosive chloride is one of our most powerful antiseptics, a single application of a solution, of one part in a thousand, destroying microzymes and their spores in a few minutes.

In many forms of infantile diarrhœa mercury is found useful, and the best plan is to dissolve a grain of corrosive sublimate in ten ounces of water, and give the child a teaspoonful every hour. This plan of treatment is especially indicated when the motions are green, slimy, and very offensive.

The red iodide [or biniodide] corresponds to corrosive sublimate, while the yellow iodide [formerly termed the green iodide] is the protiodide and corresponds to calomel.

Sal-Alembroth is a double-chloride of mercury and ammonium. It is a powerful antiseptic, but, as it combines with albumin less readily than the corrosive chloride, it is not so irritating to animal tissues.

In the treatment of eczema, and some other chronic skin-affections, preparations of mercury, applied locally, are useful. The following is the formula for unguentum metallorum :

Dilute Ointment of Nitrate of Mercury,
Ointment of Glyc. of Subacetate of Lead,
Zinc Ointment, Equal parts.

[PREPARATIONS.—Hydrargyrum Ammoniatum; Hydrargyrum cum Creta; Hydrargyri Chloridum Corrosivum; Hydrargyri Chloridum Mite; Hydrargyri Cyanidum; Emplastrum Hydrargyri, 30.24 per cent.; Hydrargyri Iodidum Flavum; Hydrargyri Iodidum Rubrum; Liquor Arseni et Hydrargyri Iodidi, 1 per cent. of each; Liquor Hydrargyri Nitratis, 60 per cent. ; Massa Hydrargyri, 33 per cent.; Oleatum Hydrargyri, 20 per cent.; Hydrargyri Oxidum Flavum; Hydrargyri Oxidum Rubrum; Hydrargyri Subsulphas Flavus; Unguentum Hydrargyri, 50 per cent.; Unguentum Hydrargyri Ammoniatum, 10 per cent.; Unguentum Hydrargyri Nitratis, 7 per cent.; Unguentum

Hydrargyri Oxidi Flavi, 10 per cent.; Unguentum Hydrargyri Oxidi Rubri, 10 per cent.; Emplastrum Ammoniaci cum Hydrargyro.]

TARTARATED ANTIMONY

This is the substance known as tartar emetic. It is called "tartarated" antimony because it is a tartrate of antimony and potassium.

When tartar emetic is given in small doses it produces some diminution in the force of the pulse and an increase of perspiration. When the dose is larger the symptoms are: Prolonged nausea, violent retching and vomiting, with muscular relaxation and general weakness. Saliva is increased in quantity, and the skin is covered with sweat.

With toxic doses all symptoms are greatly intensified. The vomiting is violent, repeated and continuous, and is accompanied with colicky pain in the stomach. The vomited matter consists first of mucus, then of mucus and bile, and finally of mucus and bile mixed with blood. Purging is a prominent symptom, the stools resembling those of cholera. There are cramps in the extremities, and well-marked exhaustion. This is followed by symptoms of collapse, the pulse being thready or hardly perceptible; the countenance livid, pinched, and anxious; the voice weak or suppressed; the temperature falls, and the skin is covered with cold, clammy sweat. Taken internally, it may produce a pustular rash like the eruption of smallpox, and both vesicles and pustules have been noticed on the mucous membrane of the mouth, throat, and œsophagus. These spots may be due to the direct contact of the drug; but it is worth noting that the favorite site of the eruption is on the genitals and inner surfaces of the thighs. Antimony, even in large doses (unlike arsenic), never causes suppression of urine. When an ointment of it is rubbed into the skin, it produces a rash which is at first papular, then vesicular, and finally pustular, closely resembling the rash of small-pox, and often leaving scars. Such an ointment, under the name of "pox salve," was at one time largely employed as a counter-irritant in cases of meningitis and mental disturbance. Effects were often very severe when it was applied freely to the scalp, perforation of both lamellæ of the parietal bones, as a result of the necrosis induced by the application, having been recorded.

In the lower animals, tartar emetic produces paralysis of the motor and sensory nerves, with loss of reflex action, and, like arsenic, it destroys the functions of all organs of the body in the order of their vital endowment. It acts not only on the sensory and motor nerves, but on the cord and even on the muscles. It is a general protoplasmic poison, destroying the functions of all the nitrogenous tissues. It weakens the heart in this way, and acts as a general depressant. It acts even on the skin, rendering the skin of frogs so soft and gelatinous that it can be scraped off readily.

In man, antimony is eliminated partly by the kidneys and partly by the liver. A portion is retained in the body. It increases the elimination of urea, carbonic acid, and, to a smaller extent, of uric acid and pigments.

Antimonial wine is a fairly good diaphoretic, and may be given with advantage in the early stages of phthisis when febrile symptoms are well marked. The following mixture is useful in these cases :

Carbonate of Ammonium,	ʒ ij.
Antimonial Wine,	♏ xxiv.
Water,	to ℥ viij.

Two tablespoonfuls to be taken every four hours with one tablespoonful of

Citric Acid,	gr. clx.
Water,	to ℥ iv.

In small doses, tartar emetic is useful in the dyspnœa of young children due to a commencing attack of bronchitis.

A grain should be dissolved in half a pint of water, and of this a teaspoonful may be given every ten minutes for the first hour, and subsequently hourly, until relief is obtained.

[PREPARATIONS.—Vinum Antimonii, 4 per cent., or ¼ grain to 1 fluidrachm; Syrupus Scillæ Compositus, 2 per cent., or ⅛ grain to 1 fluidrachm.]

ARSENIC

The substance commonly called arsenic is arsenous acid or white-arsenic. Arsenic is fatal to many of the lower forms of animal life, but does not check fermentation. With frogs it has a peculiar effect on the skin, producing degeneration and partial solution of the protoplasm of the cells. Small doses are very fatal to frogs, a thirty-thousandth of the weight of the animal producing complete paralysis, and an eighty-thousandth proving fatal in three days. In frogs it paralyzes first sensation and reflex action, then voluntary power. The prolonged use of arsenic has, on pigs and fowls, the same effect as phosphorus. Bones become more compact, and the heart, liver, and spleen undergo fatty degeneration.

It is well known that arsenic is given to horses to improve the sleekness and condition of their coats. Either a pinch is sprinkled among the oats, or a piece the size of a pea is wrapped in linen and tied to the bit. When once a horse gets accustomed to arsenic he suffers if he is deprived of it, becoming low-spirited and incapable of exertion. It produces no change in the unbroken human skin; but, when applied to wounds or sores, excites active inflammation. It is a general protoplasmic poison, destroying the functional activity, first of the central nervous system, next of the sensory and motor nerves, and finally of the muscles. It speedily arrests action of the heart by affecting all its structures—ganglia, nerves, and muscle. It lowers arterial-tension in mammalia, partly by its action on the heart, and partly through its influence on the vasomotor nerves.

Arsenic is absorbed by the stomach, though probably not in the form of an albuminate. It excites a feeling of warmth at the pit of the stomach and improves the appetite. After absorption into the blood, arsenic appears to modify tissue-change.

In man, tolerance is soon established. In some parts of Lower Austria, in Styria (especially the hill-country toward Hungary) people take arsenic as a condiment or sweetmeat. The drug is there known by the name of *nidri*, and is sold to the people by itinerant peddlers and herbalists. The men eat it to improve the wind and enable them to climb the mountains; the women, to improve their looks, and because the men do. In some places the experiment is performed for the edification of visitors, the investigator being invited to bring his own arsenic and recover it from the urine. The effect on the men is astonishing. They at once feel invigorated, and easily ascend mountains which, at other times, they could not surmount without much difficulty and distress of breathing. The quantity to commence with varies with age and physical condition, but never exceeds half a grain. The dose is taken on alternate days before breakfast, and the quantity is increased as tolerance is established. No unpleasant symptoms result if the established rules are observed. If, however, the custom is discontinued, considerable inconvenience is experienced so that a return to the practice is necessitated.

Very serious effects are sometimes produced by the use of arsenic in wall-papers and articles of domestic use. "It is an unquestionable fact that the general health is suffering, from the use of arsenic and other poisons in the manufacture of domestic fabrics, to an extent not yet fully appreciated by the public, notwithstanding that, from time to time, the injurious effects have been pointed out by numerous medical and chemical authorities whose attention has been given to the question."[1]

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[1] Carr: "Our Domestic Poisons."

Arsenic is not only used in the manufacture of wall-papers, but is also found in candles, carpets, advertisement and playing-cards, ornaments for children's toys, india-rubber balls, dolls, japanned goods, Venetian-blinds, floor-cloth, bookbindings, artificial leaves and flowers, violet-powder, sweets, hat-linings and gloves, and a number of other substances. My colleague, Dr. Wilson Hake, has found large quantities of arsenic in the green paper wrapper of a well-known brand of cigarettes.

The fact of a wall paper being marked "non-arsenical" is no proof that it is free from arsenic. Carr says: "A paper selected by the writer, marked 'non-arsenical,' was found, after being hung, to be highly arsenical, and this from a first-class London firm of the highest respectability." Emerald-green (a compound of arsenic and copper) is extensively employed in the manufacture of various kinds of wall-paper. Some years ago a manufacturer boasted that he never used less than two tons a week.

Arsenic has frequently been detected in the dust on books, picture-frames, and furniture of rooms so papered, and workmen who handle these papers not infrequently suffer from arsenical poisoning. It is not only the green papers which are dangerous, for arsenic in various combinations is used in a great variety of colors, and even in French-white. In Germany the use of arsenic in the preparation of wall-papers was long since prohibited under a heavy penalty. In England arsenic is not so largely employed for the purpose as formerly, and one or two of our makers have established a world-wide reputation for wall-papers which will bear the most careful scrutiny with regard to their freedom from this deadly drug.

The symptoms of chronic arsenical poisoning are faintness, great depression, nausea and vomiting, purging, sense of constriction in the œsophagus, coryza, cough, wasting, and hæmoptysis. These symptoms are below tabulated according to the parts affected and the frequency of their occurrence:

Stomach and Bowels.—Diarrhœa and dysentery, pain in abdomen, nausea and vomiting, loss of appetite, thirst.

Eyes.—Conjunctivitis and sore lids.

Nervous System.—Depression of spirits, restlessness, sleeplessness, nightmare, and headache.

Throat, Nose, and Respiratory Organs.—Soreness of throat, ulceration and dryness, bronchial catarrh, asthma, symptoms resembling ordinary cold in the head with much running of tears, spitting of blood accompanied with progressive loss of flesh.

It should be remembered that, in cases of chronic or slow arsenical poisoning, the symptoms often very closely resemble those of chronic gastritis, or ulceration of the stomach. Chronic arsenical poisoning is often mistaken for phthisis. A rash may appear on the skin, assuming the form of eczema or urticaria, and the hair and nails sometimes fall off.

Arsenic may be introduced into the lungs as a fine dust, or in the form of arseniuretted hydrogen.

It is eliminated from the body by the kidneys, intestines, and, perhaps, by the liver. It can be detected in the bones long after all traces have disappeared from the viscera.

The celebrated "aqua tofana"—used by Hieronyma Spara, who presided over a society whose diversion it was to poison their own and other women's husbands—was made by rubbing white-arsenic into pork and collecting the fluid which drained from it when exposed for some days to the heat of the sun. It was a very active poison, which defied detection by chemical investigation, and probably consisted of a mixture of arsenites of cadaverine, putrescine, and other ptomaïnes.

THERAPEUTICALLY, arsenic is a very valuable remedy. In large doses it is given with success in the treatment of asthma. Arsenical cigarettes are smoked with advantage, not only to relieve the dyspnœa of asthma, but in cases of chronic bronchitis. Small doses of arsenic, frequently repeated, afford relief in cases of persistent sneezing accompanied by a profuse discharge of watery fluid from the eyes and nostrils. These small doses are also useful in irritative dyspepsia when the tongue is furred and its papillæ are red and prominent. Arsenic is especially useful in that form of dyspepsia in which, in consequence of exaggerated peristaltic action of the stomach and intestines, the patient has an evacuation of the bowels immediately on taking food. Large doses of arsenic are useful in psoriasis and nearly all scaly skin-diseases. The addition of a hundredth of a grain of arsenous acid to the sulphate of iron pill increases its efficacy in the treatment of anæmia.

[PREPARATIONS.—Liquor Acidi Arsenosi, 1 per cent.; Liquor Potassii Arsenitis (Fowler's Solution), 1 per cent.; Arseni Iodidum; Liquor Arseni et Hydrargyri Iodidi (Donovan's Solution); Liquor Sodii Arsenatis; Sodii Arsenas.]

BISMUTH

The most important official salts of bismuth are the subcarbonate, subnitrate, and the citrate.

The carbonate and subnitrate, when applied to the skin, act as sedatives, and under the name of Spanish-white or pearl-white are largely used as cosmetics. The only objection to their use is that they are apt to turn black when brought in contact with sulphuretted-hydrogen or illuminating gas. The carbonate and subnitrate are both insoluble, and are apt to cause a sensation of roughness in the mouth and to blacken the tongue. They act as sedatives to the mucous membrane of the stomach, and probably act mechanically rather than chemically. Possibly a small quantity may be rendered soluble by the acid secretion of the stomach. The greater part of the salt passes into the intestines unaltered, and acts as a sedative and slight astringent. It is eliminated with the fæces, to which it gives a dark slate-color. Any constitutional effects produced are probably due to contamination with arsenic. The dose of the subcarbonate usually administered is too small, and in cases of diarrhœa a drachm or more may be given with advantage.

Some people on taking bismuth suffer from what is called "bismuth breath." This is not observed in every case, but in a certain proportion of cases an odor like that of garlic is produced. What this is due to is not very clear. It has been customary to attribute it to the presence of arsenic (traces of which are found in most specimens of bismuth); but in some cases in which it has been very pronounced, the bismuth has been examined for arsenic and none has been found. It is probably due to the presence of a minute trace of tellurium. The case is recorded of a student who took tellurium experimentally, and whose breath became so offensive that he had to sit apart from his fellow-students during the remainder of the session.

Bismuth is of much value in gastric ulcer and in all painful affections of the stomach. It should always be given in an empty stomach, and is usually suspended in a mixture by mucilage of acacia or of tragacanth. It promptly relieves the nausea and vomiting due to irritation of the stomach. The general experience is that the subcarbonate or subnitrate are much more useful than a solution.

[PREPARATIONS.—Bismuthi Citras; Bismuthi et Ammonii Citras; Bismuthi Subcarbonas; Bismuthi Subnitras.]

IRON

[Iron is taken into the system in small amounts with foods and drinks of many kinds. Certain natural waters contain so considerable quantity as to be used medicinally.] It is a constant and necessary constituent of the body, and may be regarded as a food rather than a medicine. It forms an important constituent of the hæmoglobin of the blood. Some salts of iron are inorganic, while others are organic. Of the inorganic salts some are ferrous, while others are ferric. The inorganic salts are more astringent than the organic, and ferric salts are more astringent than the ferrous.

ACTION.—The soluble salts of iron have a metallic taste and act as astringents to the mouth. They are not used as topical applications to the mouth, therefore, as they stain the teeth and tongue black by formation of a sulphide with the sulphuretted-hydrogen arising from decayed teeth and offensive breath.

The astringent preparations (such as the chloride) act as stimulants and irritants to the mucous membrane of the mouth, while the non-astringent preparations exert little or no action. The soluble salts combine with albumen in the stomach, forming soluble ferrous and ferric compounds and albuminates, which, although insoluble in water, dissolve readily in the acid gastric juice. The insoluble salts are dissolved to a variable extent by acid solutions. Some iron is absorbed from the stomach; but much of it passes into the intestines, where it is converted into an insoluble sulphide. After absorption into the blood, iron increases the number of blood-corpuscles and the percentage of hæmoglobin contained in them. This effect is much more marked in anæmia, where the proportion of red corpuscles is deficient, than in health. A little free iron may be detected in the blood-serum. Oxidation in the tissues, together with functional activity of the various organs, is increased by iron. Absorption, however, is so small that a dog fed with sulphate of iron daily, excretes with the urine only $\frac{1}{16}$ of a grain of iron more than he does with a pure meat-diet.

It is probable that much of the beneficial action of iron in certain diseases is due to its influence on the mucous membrane of the stomach—an explanation which accords with the generally-accepted experience that the astringent preparations are much more useful than those which are bland and unirritating.

When injected hypodermically, iron produces, in frogs, first excitement and then paralysis of the central nervous system. In mammals, it causes paralysis of both sensation and motion. The blood-pressure falls, owing to paralysis of the vaso-motor nerves, principally those of the intestine. Its action in this respect is similar to that of arsenic, antimony, and of some other drugs.

Iron is mostly eliminated with the fæces, which it stains black, a very small quantity sufficing for this purpose. Even when iron is injected into the circulation it is eliminated by the intestines. It exerts no action on the biliary or pancreatic secretions. Some iron is eliminated by the kidneys and can be detected in urine by the usual reagents, especially sulphide of ammonium—a proof, apart from the therapeutical action of the drug, that some of it is absorbed.

None of the preparations of iron applied to the skin produce any change, but the astringent and styptic preparations, if applied to abraded surfaces, act as stimulants or irritants, coagulating the albumin and constringing blood-vessels.

THERAPEUTICS.—There are many people who declare that they "cannot take iron," and it is undoubtedly the case that many patients, on taking it in unusually large doses, or for a prolonged period, suffer from disturbance of digestion, diminution of appetite, gastric oppression, and even vomiting. In rare cases hæmorrhage from the mucous membranes has been noted, and with delicate, anæmic women the eruption of acne spots on the face, breasts, and back is not uncommon. Blackening of the teeth is more likely to occur when they are carious, sulphuretted-hydrogen precipitating the iron, in the form of a sulphide, from the solution in which it is held by the alkaline secretion of the mouth. Even when teeth are perfectly sound, blackening may still occur from the presence of tannic acid in various articles of food, and in tea and other drinks, the precipitate, in this case, being a tannate and not a sulphide of iron.

One of the chief therapeutical uses of iron is as a hæmatinic. The mistura ferri composita is known as Griffiths' Mixture, after Dr. Moses Griffiths, who flourished in the last century. [Mistura ferri aromatica, which is official in Great Britain, is commonly called Heberden's Ink.]

Sulphate of iron exists in three forms—sulphate, dried sulphate, and granular sulphate. The dried sulphate, which contains no water of crystallization, is useful for making pills. Five grains of it are equivalent to nine grains of the ordinary sulphate. Blaud's pills are official as pilulæ ferri carbonatis, and are largely used in the treatment of anæmia. They consist of the sulphate and carbonate of iron, with powdered tragacanth and other excipients. A double decomposition takes place, carbonate of iron and sulphate of potash being formed. The therapeutical action of sulphate of potassium in this dose is practically *nil.* Blaud's pills simply afford a convenient mode by which to administer freshly-prepared carbonate of iron.

The **carbonate** is a ferrous salt insoluble in water, unirritating and not astringent. The presence of sugar prevents it from being converted into ferric oxide. These pills are prescribed in mild cases of anæmia, and are extensively advertised, but their popularity is in excess of their merits. They are sold as a proprietary preparation in some countries, and are often incorrectly described in text-books as "Bland's pills." They are not nearly so useful as are pills made with dried sulphate of iron and a drop or two of simple syrup. This last method is not popular with chemists, as it requires some skill to make the pills; but they are easy enough to make when you know how.

An excellent combination in cases of anæmia is the following:

Dried Sulphate of Iron,	gr. iij.
Arsenous Acid,	gr. $\frac{1}{100}$.
Simple Syrup,	gr. ss.

To make a pill. One should be taken three times a day after meals.

It is essential that these pills should be made with syrup, and with syrup alone. If they are made with extract of belladonna, or extract of gentian, the sticky mass adheres to one portion of the mucous membrane of the stomach, and the result is that the patient suffers intense pain and, not infrequently, develops symptoms of ulceration of the stomach. If made with simple syrup, the mass disintegrates at once, and is distributed throughout the contents of the stomach in a form in which it can be readily absorbed.

Chloride of iron is met with as liquor ferri chloridi or solution of chloride of iron, and tinctura ferri chloridi.

Dialyzed iron occurs in the form of the solution: liquor ferri dialysatus. It consists of a highly-basic ferric oxychloride, from which most of the acidulous matter has been removed by dialysis.[1]

Various albuminates of iron have recently been employed with much success. Ferratin—an iron derivative of acid-albumin, discovered by Schmiedeberg and Marfori, of Strassburg—is one of the best.

[PREPARATIONS:

Ferri Carbonas Saccharatus
  " Chloridum
  " Citras
  " et Ammonii Citras
  " et Ammonii Sulphas
  " et Ammonii Tartras
  " et Potassii Tartras
  " et Quininæ Citras

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[1] The process of dialysis was discovered by Graham in 1861, and consists of separating crystallizable substances from those which do not crystallize, by pouring a mixture of both on a porous diaphragm, the under surface of which is in contact with water. The substances which pass through the septum are called "crystalloids," from their power of forming crystals, while those which remain upon the diaphragm are called "colloids," from their resemblance to gelatin and because they do not crystallize. One of the most convenient dialyzing agents is parchment-paper, prepared by brief immersion of unsized paper in dilute sulphuric acid.

[PREPARATIONS :

- Ferri et Quininæ Citras Solubilis
  - " et Strychninæ Citras
  - " Hypophosphis
  - " Iodidum Saccharatum
  - " Lactas
  - " Oxidum Hydratum
  - " Oxidum Hydratum cum Magnesia
  - " Phosphas Solubilis
  - " Pyrophosphas Solubilis
  - " Sulphas
  - " Sulphas Exsiccatus
  - " Sulphas Granulatus
  - " Valerianas
- Ferrum Reductum
- Emplastrum Ferri, 9 per cent.
- Liquor Ferri Acetatis, 7.5 per cent. of metallic iron
  - " Ferri Citratis, 7.5 per cent. of metallic iron
  - " Ferri Chloridi, 37.8 per cent.
  - " Ferri et Ammonii Acetatis (Basham's Mixt.)
  - " Ferri Nitratis, 1.4 per cent. of metallic iron
  - " Ferri Subsulphatis, 13.6 per cent. of metallic iron (Monsel's Solution)
  - " Ferri Tersulphatis, 8 per cent. of metallic iron
- Massa Ferri Carbonatis (Vallet's Mass)
- Mistura Ferri Composita (Griffiths' Mixture)
- Pilulæ Aloes et Ferri, 1 gr.
  - " Ferri Carbonatis (Blaud's Pills)
  - " Ferri Iodidi
- Syrupus Ferri Iodidi, 10 per cent.
  - " Ferri, Quininæ et Strychninæ Phosphatum, 2 per cent.
  - " Hypophosphitum cum Ferro, 1 per cent.
- Tinctura Ferri Chloridi, 13.6 per cent.
- Trochisci Ferri, 4½ grains
- Vinum Ferri Amarum, 4 per cent.
  - " Ferri Citratis, 5 per cent.]

PHARMACOLOGY

OF

SYNTHETICAL COMPOUNDS

PHARMACOLOGY

OF

SYNTHETICAL COMPOUNDS

ALCOHOL

[Ethyl alcohol is the only one of numerous alcohols which is implied by the official title. It exists, as defined by the Pharmacopœia, in four forms: *Absolute Alcohol*—containing more than 1 per cent., by weight, of water; *Alcohol*—containing about 91 per cent., by weight, of ethyl alcohol; *Diluted Alcohol*—having about 41 per cent. of absolute alcohol; and *Deodorized Alcohol*, of which about 92.5 per cent. is absolute alcohol.]

Rectified-Spirit [as it is known in Great Britain] is ethyl alcohol with 16 per cent. of water—*i.e.*, it contains 84 per cent. of alcohol. It is the product of the vinous fermentation of sugar contained in wine, malt liquors, etc. These, when distilled, yield brandy, rum, etc., and, when redistilled, rectified spirit. By the distillation of a fermented liquor, a mixture of alcohol and water, containing as little as 10 per cent. of water, can be obtained; but this mixture cannot be separated by further distillation, as the two liquids go over together in these proportions without further division.

Proof-Spirit contains about 49.24 per cent. of absolute alcohol, so that it is practically half spirit and half water. Every half per cent. of alcohol over this corresponds to one degree over proof. The strength of alcohol was formerly tested by moistening gunpowder with it and setting fire to the spirit. If the powder exploded, the spirit was said to be "over-proof," but if it contained too much water to do this, it was said to be "under-proof."

Absolute Alcohol is made from rectified spirit by redistilling it with dry potassic carbonate ; but, in order to dry it completely, it ought, finally, to be mixed in a retort with its own weight of quick-lime in lumps and, after standing for some days, be again distilled. The first portions collected contain the moisture of the apparatus and should be rejected. Alcohol mixes with water in all proportions, and the mixture occupies a smaller bulk than the alcohol and water occupied previous to mixing.

Methylic Alcohol is one of the products of the dry distillation of wood. The watery liquid is separated from the tar and distilled and, after being purified, is redistilled.

Methylated Spirit is ethyl alcohol mixed with 10 per cent. of wood-spirit.

In the British Pharmacopœia the Spiritus vini Gallici or French brandy and Vinum Xericum [sherry wine] are official. In the United States Pharmacopœia, in addition to brandy, whiskey, white wine, and red wine are official.

[The latter recommends, when either of the two last-named are prescribed without specification, that, for the former, "a dry, white wine of domestic production (such as California Riesling, Ohio Catawba, etc.)," and for the latter, "a dry, red wine of domestic production (such as a native Claret, Burgundy, etc.)," be employed.]

Wines and **distilled liquors** contain—in addition to alcohol—water, salts, and various volatile ethers and flavoring agents. The following table shows the percentage of alcohol contained in the common varieties :

Rum,	60 to 70 per cent.
Brandy,	45 to 55 "
Whiskey,	50 to 60 "
Gin,	49 to 60 "

Port,	20	per cent.
Sherry,	15 to 19	"
Burgundy,	13 to 14	"
Claret,	10 to 17	"
Hock,	8 to 10	"
Champagne,	6 to 13	"
Strong ale,	6	"
Stout,	6	"
Porter,	4	"
Small beer,	1	"
Teetotal drinks,	6 to 14	"

Liqueurs, such as Gin, Chartreuse (green and yellow, the former being much the stronger), Curaçoa, Maraschino, Kümmel, and Bénédictine, are generally supposed to be innocuous; but they contain a large percentage of alcohol and, although the dose is small, they are saccharine, and the combination of alcohol and sugar is especially injurious. Probably the least injurious of liqueurs is dry Gin, which, although strong in alcohol, contains practically no sugar.

Alcohol is largely used in pharmacy, especially in the preparation of tinctures [and fluid-extracts]. It is employed when the active portion of the drug is sparingly soluble in diluted alcohol. The latter is used when active ingredients are soluble partly in alcohol and partly in water.

Some years ago the Temperance party [in England] thought it wrong to use tinctures made with alcohol, and ordered glycerin to be substituted for the spirit. The new tinctures were all right, excepting that, in the majority of cases, they contained none of the activity of the plant.

Action.—The physiological action of alcohol presents many points of interest: When applied to the skin and allowed to evaporate, it contracts the blood-vessels locally, and produces a sensation of cold. This property is taken advantage of by surgeons who employ evaporating lotions, composed largely of alcohol, as applications to inflamed tissues, a common formula being two and a half ounces of diluted alcohol with half a pint of water.

Applied to the skin in a concentrated form, it thickens and hardens the epidermis. It is a well-known custom to rub the buttocks of bed-ridden patients with brandy, or eau-de-Cologne, to prevent the formation of bedsores. It coagulates albuminous solutions by withdrawing water. Thus, when taken into the mouth, it forms, with the secretions, a thin layer of coagulated albumin. It also acts as an astringent to the mucous membrane, and is useful in checking bleeding from the gums and in promoting the healing of small ulcers. In the stomach, it excites a feeling of warmth, accompanied by increased vascularity and increased secretion. This affords an explanation of the common custom of taking gin-and-bitters before meals, or a glass of sherry at the commencement of dinner.[1] Alcohol also assists in the expulsion of flatus from the stomach, an action which is familiar to us in the relief afforded by various cordials in cases of colic and allied conditions. When alcohol is taken habitually in excess, it gives rise to chronic gastric catarrh, so that the patient suffers from nausea and vomiting in the early morning before breakfast.

In the intestine alcohol acts as an astringent. and port wine is with many people a favorite remedy for a slight attack of diarrhœa. When, however, alcohol is taken too freely, it stimulates the secretions, and habitual topers are rarely constipated. In the case of the light French wines, which are of little alcoholic strength and are usually consumed in fairly large quantities, the presence of various salts in solution probably accounts for the laxative action.

In the blood alcohol forms a compound with hæmoglobin, which takes up and gives off oxygen less readily than hæmoglobin itself. Alcohol lessens the oxidizing power of the blood and diminishes waste. It is diffused uniformly throughout the body, excepting that the blood usually contains a higher percentage than the organs. It is, in great part, split up into carbonic acid and water; but a small portion is eliminated unchanged with urine and by the lungs. The peculiar and characteristic odor of the breath of chronic alcoholics is well-known. After an alcoholic debauch the specific gravity of the urine is sometimes lower than that of water.

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[1] Almost all "bitters" are made of gentian. The gentian improves appetite, and the alcohol, by increasing the secretion of gastric juice, provides means for digesting the food.

Alcohol has a marked effect on the circulation. It stimulates the heart's action and dilates the superficial blood-vessels. The veins are dilated, and the blood passes so quickly through the vessels that it has no time to become venous. This effect on the circulation explains the flushing of the face which follows administration of alcohol, and also the throbbing feeling in the head and, to a less extent, all over the body, which is so often experienced. The temperature falls because a larger surface of blood is exposed to the surrounding atmosphere.

Alcohol also induces sweating, and this may have something to do with the fall of the temperature. In large doses the diminished tissue-change is an important factor. Every one knows that Arctic travellers, and others exposed to intense cold, should not take alcohol. The effect would be to dilate the superficial blood vessels and bring down the temperature of the body. If, however, a person who has become chilled takes a glass of hot brandy-and-water as soon as he gets home, it proves beneficial by dilating the blood-vessels in an atmosphere considerably warmer than that to which he has been exposed. When a person is suffering temporarily from the effects of an overdose of alcohol, he may materially improve his condition by lying for a couple of hours in a very hot bath. The common explanation is that "it sweats the drink out of him," but probably what really happens is, that the superficial blood-vessels are dilated so that the alcohol in the body is distributed over a wider area, and is applied less freely to the central nervous system.

The effect of alcohol on the nervous system is very marked, the highest centres being first affected. To begin with, the imagination is excited, and the person loses his habitual timidity and self-consciousness. The nervous, shy man finds himself talking freely to his fair neighbor at dinner, and doing his best to make himself agreeable. In ordinary society, when ladies are present, the effect of alcohol is not carried beyond this stage. At a large public dinner, however, rather more wine is taken, and the diffident speaker suddenly finds himself on his legs, returning thanks with great fluency for the guests of the evening. He may be making a fool of himself, but he is oblivious of the fact. At a man's-dinner, when there is less restraint, the dose of alcohol is often carried to the extent of impairing the judgment. He tells his host the amount of his income, blabs about some African shares which are worth picking up and are likely to go better, and, being a respectable married man, suggests that they should go to the "Empire" or take a stroll down Piccadilly.

Up to this point no particular harm is done, and all that can be said of the person is that he "has been dining"; but if he goes a little further his emotions are excited, and he invites casual acquaintances to come and stay with him for a week. He is now in a maudlin condition, and is generally said to be "a little bit on." After this the downward course is rapid. His motor-centres get affected, and he finds some difficulty in articulating, especially when he endeavors to remark that it is a truly rural view. Then the cerebellum comes into play, and he experiences the delights of "seeing double," accompanied by a sensation that the pavement might have been made wider with advantage. A policeman puts him into a cab, but he is unable to give his address, and probably spends the rest of the night in a police-station. If not looked after, he falls into a state of somnolence and insensibility, the respiratory-centre suffers, and he becomes comatose, or "dead drunk." Still, with care, he is safe; but if left exposed to cold night-air, or not properly looked after, the heart's action becomes weakened and he dies.

Alcohol possesses the valuable property of dulling the sensibility of the vaso-motor centre to reflex impressions, so that there is an almost complete absence of shock from an accident or injury received whilst in this condition. It is often said that Providence watches over drunken men, and this is the physiological explanation of it.

When alcohol is habitually taken in excess, it induces a train of symptoms to which we apply the term alcoholism. This condition is the result of a more or less continuous use of alcohol, and differs from the immediate effects of a considerable overdose, to which we apply the terms intoxication, drunkenness, or inebriety.

ANÆSTHETICS

This is a name—originally proposed by Dr. Oliver Wendell Holmes—given to a series of agents employed for the prevention of pain, and applied especially to those used in surgical practice. Anæsthetics are divisible into :

General Anæsthetics, which include chloroform, ether, nitrous-oxide, ethidene bichloride, etc., and

Local Anæsthetics, chiefly such as ether, bromide of ethyl, cocaine, and cold.

Carbolic acid will produce temporary local anæsthesia of the skin, and so will many of the essential oils. Menthol, thymol, oil of peppermint, and oil of cloves are, therefore, useful applications in the treatment of neuralgia. Aconitine is used locally in the treatment of many painful affections, but not for the performance of surgical operations.

The history of the discovery of anæsthetics is a curious one : In 1798 Mr. Humphry Davy, then twenty-two years of age, published his "Researches, Chemical and Philosophical, chiefly concerning Nitrous-Oxide," in which he says : "As nitrous-oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations." No notice was taken of this, but for many years subsequently [illegible] inhalation of nitrous-oxide was a favorite experiment [illegible] lectures on chemistry.

In 1844 Mr. Colton delivered a popular lecture on "Laughing Gas" at Hartford, Connecticut. In the audience was Dr. Horace Wells, an enterprising dentist of that city. He noticed that people under the influence of the gas did not hurt themselves when they fell. The following morning he had one of his own teeth extracted, under gas administered by Mr. Colton. During the following three weeks Wells extracted teeth from fifteen people under the influence of the gas. Wells went to Boston to demonstrate his method at the medical college. The gas was administered for the extraction of a tooth; but the patient cried out, and Wells was denounced as an impostor and a fraud.

For many years ether was used for the relief of spasmodic asthma, and for the dyspnoea of phthisis and other diseases of the chest. In the "Journal of Science and Arts," published at the Royal Institution, the following appeared in 1818, and has since been attributed to Faraday: "When the vapor of ether mixed with common air is inhaled it produces effects very similar to those occasioned by nitrous-oxide."

No notice was taken of this, and some years later we find that ether was commonly used in what were called "ether-frolics." In 1842 Dr. Long, of South Carolina, becoming acquainted with the effects produced by ether, induced a Mr. Venable to inhale the vapor while a tumor was removed from his neck. The only record made of the operation was in his ledger, the entry being:

"James Venable, 1842; ether and excising tumor, $2."

Dr. Long operated on three other people between 1842 and 1845, but refrained from publishing his discovery.

Wells, during his unlucky visit to Boston in 1844, had talked over the matter with Dr. Morton, a rough, energetic dentist, and with Dr. Charles Jackson, a quiet, scientific dentist. In 1846 Morton tried ether on himself, and remained insensible for eight minutes. Instantly, as he tells us, he looked for an opportunity of giving it to a patient, and a stout, healthy man coming in just at the critical moment, he induced him to inhale, rendered him quite insensible, and drew one of his teeth without causing the slightest pain. A month later Morton gave ether to a patient in a hospital, and a tumor was removed with complete success.

Some years later Dr. Simpson, of Edinburgh, suggested the employment of anæsthetics in childbirth, and substituted chloroform for ether.[1]

The subsequent history of the men who introduced anæsthesia is instructive—and encouraging.

Wells, after his failure at Boston, went home disheartened, and was long ill and unable to practise his profession. He gave up dentistry and went into picture-dealing. He tried to get some reward for the priority of discovery, but was constantly disappointed, and finally *committed suicide.* Twenty years afterward, his statue was set up in Hartford, and five years later, his widow being destitute, a subscription was raised on her behalf.

Dr. Long lived quietly and little-known till 1878, when he died. *He received no reward or honor of any kind.*

Morton, after taking out his patent, had many lawsuits and disputes. He petitioned Congress for some grant or reward and, after waiting for twenty-two years, *committed suicide* by drowning.

Jackson was equally unsuccessful in his endeavors to obtain recognition, and finally *ended his days in a lunatic asylum.*

Simpson was made a baronet; had a statue erected to him in Edinburgh and a bust in Westminster Abbey.

Such is the history of the discovery of anæsthesia.

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[1] [Chloroform, as a substance, was discovered in 1831 by Mr. Samuel Guthrie, of Sackett's Harbor, N. Y.]

CHLOROFORM

Chloroform is made by the action of chlorine on alcohol. It dissolves india-rubber ; gutta-percha ; many resins, fats, and alkaloids, and is decomposed by potash and soda. It should not be made from methylated spirit, and, when poured on blotting-paper, should leave no unpleasant smell. It was first used as an anæsthetic in 1847, by Dr., afterward Sir James Y. Simpson.

When applied to the skin, it evaporates rapidly and leaves a feeling of cold. When evaporation is prevented, it passes through the epidermis, produces a burning sensation, the skin is reddened, and, if the application is prolonged, there may be vesication. The counter-irritation produced by chloroform is utilized in many painful affections. A chloroform poultice, made by sprinkling chloroform on a pad of lint, will check the pain of lumbago, and is a useful application to the abdomen in cases of colic. The patient should keep it on as long as he can bear the smarting, and then shift its position.

In the mouth, chloroform stimulates the mucous membrane and increases the flow of saliva. When swallowed in small quantities, it increases and co-ordinates movements of the stomach and intestines, expelling flatus and relieving the pain of colic. In attacks of vomiting or of indigestion with flatulence, a common remedy is three drops of chloroform in a wineglassful of water. In large doses it produces gastro-enteritis, and, ultimately, as it becomes absorbed, gives rise to much the same symptoms as if it were inhaled. It is often swallowed by lunatics for suicidal purposes. When a large quantity has been taken its characteristic odor is noticed in the breath. The patient usually presents an anxious appearance, and complains of a burning pain in the throat, stomach, and bowels. There is coldness of the extremities, with staggering gait. There may be vomiting, but the patient soon becomes insensible, and passes into a condition of coma with complete anæsthesia, dilated pupils, and stertorous breathing. From one to two ounces usually prove fatal.

Chloroform, whether absorbed from the stomach or the lungs, has a marked influence on the nervous system. It paralyzes the nervous centres in much the same order that alcohol does ; but with this difference, that in the case of chloroform there is not the preliminary stage of excitement which is such a prominent feature with alcohol.

One of the first effects of chloroform is abolition of sensation and voluntary motion. If it would do no more than that it would be a boon, although the work of the surgeon would be frequently interrupted, and often marred, by involuntary struggles on the part of a patient. But, fortunately, the spinal cord is also subdued, and the reflex functions of the cerebro-spinal axis are abolished so far as concerns the voluntary muscles, which are rendered passive. The centres concerned in respiration remain active, and the same is the case with the sympathetic ganglia of the heart.

Chloroform derives its utility as an anæsthetic from the fact that the respiratory-centre is the last of all the parts of the central nervous system to be deprived of activity.

This view of the physiological action of chloroform will not receive universal acceptance. For many years there has been a great discussion as to whether it is the heart or the respiration which first goes wrong in cases of death from the use of chloroform as an anæsthetic. The Edinburgh rule is practically: "Watch the respiration ; the heart will take care of itself." The scientific commission, appointed by the Nizam of Hyderabad to investigate the question, adopted this view ; but the subsequent researches of MacWilliam, Gaskell, and others, show that the verdict of the commission cannot be taken as conclusive. There is very little doubt that chloroform may paralyze the heart without first affecting the respiration, and, moreover, that paralysis of the vaso-motor centre, and consequent withdrawal of blood from the heart and brain to the dilated splanchnic area, may be an important factor in bringing about a fatal result. Stewart suggests that, in addition to the Edinburgh rule, a second should be added, to this effect: "Watch the breathing; watch the pulse. If the heart threatens to fail for want of blood, fill it by raising the legs and compressing the abdomen."

Chloroform undoubtedly exerts a powerfully depressing action on the heart. When injected into the jugular vein it instantly arrests the heart's action and destroys its muscular irritability. Vapor of chloroform applied to the exposed heart paralyzes it, and even when artificial respiration is maintained the effect is very apparent. There can be no doubt that chloroform destroys the contractile power of the heart-muscle.

A good proof that chloroform exerts a depressing action on the frog's heart, is afforded by a series of experiments made by Ringer with Roy's apparatus. The ventricle was attached to the cannula by a ligature passing round the groove between the auricles and the ventricles. The portion of the heart employed—the ventricle with a little of the groove—is free from inhibitory nerves or ganglia, so that the influence of the drug cannot be due to any action on the inhibitory apparatus. Chloroform, it was found, acts like lactic acid, muscarine and pilocarpine, in reducing the height and duration of the tracing until the heart stops in diastole. The addition of ammonia at once strengthens the heart and restores its action, but a larger dose of chloroform again arrests it in spite of the presence of the ammonia. Atropine does not antagonize the action of chloroform, and, even when atropine is added first, the chloroform still exerts its characteristic action.

Chloroform was at one time more extensively employed than now as an anæsthetic. It was said that it could be given with equal safety to men and women, to children a few days old and to centenarians. Pregnancy was held to be no bar to its administration, and a condition of collapse was not regarded as a reason for withholding its administration. It was held that the action of the drug on the brain and on the cardiac ganglia, through the medium of the vagus and sympathetic, protects the heart from the indirect effects of external violence and diminishes the risk from shock on the operating table. It revolutionized the old rule to defer operation till collapse had passed off. It eliminated the risk of secondary hæmorrhage, as, from the absence of faintness during the operation, the vessels which require ligature declare themselves by bleeding. It was said that any person who is in a fit condition to undergo a severe operation is in a fit state to take chloroform. Of late, however, these views have undergone some modification, and chloroform is not the popular anæsthetic that it was some years ago. There is one thing in its favor, which is, that it can be given to children with perfect safety.

In private practice surgeons usually prefer to operate early in the morning, and this is a decided advantage to the anæsthetist, for the patient has had no food since the previous night; is fortified by a good rest; is already in bed, and in a mental condition favorable for the production of anæsthesia. There are one or two precautions the anæsthetist always takes: He sees that false teeth are removed, and that there is no impediment, by stays or tight clothing, to full expansion of the chest.

The view now almost universally held by the most experienced observers is that chloroform is not a safe anæsthetic. A well-known surgeon said to me: "I never use it, excepting for children or for tongue-cases, and then I take care that the patient is never fully under." An equally well-known physiologist said: "When I was working with monkeys I lost a large proportion of them from chloroform, although they were healthy animals. On opening the thorax I always found that the heart had come to a standstill."

There can be no doubt that the popularity of chloroform as an anæsthetic, in this country, is on the wane. The mortality from its employment is increasing, despite the care devoted in medical schools to instruction in its use. The drawbacks of ether-administration are as nothing compared with the greater risk of fatal results undeniably associated with the administration of chloroform.

Chloroform may, perhaps, be all right in India, where ether cannot be given, the small number of deaths from chloroform amongst the natives being probably explicable, first, on the ground that the vapor is not readily given in a concentrated form, and secondly, that they are somewhat unsusceptible to its action.

The rule with regard to the administration of chloroform in the case of adults seems to be—not to give it at all; but, if it must be given, to avoid all forms of apparatus, and to let the patient inhale from a pocket-handkerchief, so that the vapor is diluted as much as possible.

There are several kinds of apparatus sold for the administration of chloroform, the intention being to afford some guarantee that the proportion of chloroform vapor to air does not exceed four-per cent. In many cases, however, no apparatus of any kind is available, and the anæsthetic is given from a napkin or pocket-handkerchief; in fact, in Scotland this method is almost universally followed. Probably more depends on the choice of a pure chloroform than on the apparatus by which it is given.

The sensation of inhaling chloroform is, on the whole, a pleasant one. Many people acquire a great liking for it. Some people dislike it, partly because it produces a choking or suffocating feeling, and partly because, as they say, they dislike to have their senses taken away.

After a few whiffs the patient experiences noises in the ears and lights before the eyes, with a feeling of weight or oppression at the chest. The heart seems to be beating wildly, and there is throbbing in the big blood-vessels. In this early stage there may be hysterical symptoms, especially with women; the patient laughing or crying or, perhaps, screaming. The pulse is usually a little quickened at first from nervousness, but it soon falls in frequency and gains in force.

In a short time all discomfort ceases, the patient becomes quiet, breathes calmly, and is evidently happy and comfortable. Consciousness is distinctly affected, for, while questions are evidently still heard, their purport is not understood, and answers are returned slowly and are not relevant. After a time there may be a period of excitement during which the patient struggles and attempts to get up; but this soon passes away, and the muscles, which before were contracted, soon assume a condition of flaccidity.

At last the patient becomes completely insensible, reflex action is lost, and pain is no longer experienced. The pupils are contracted, and the limbs, when raised, fall heavily. The signs of danger are: stertorous or shallow breathing, sudden dilatation of the pupils, and signs of heart-failure.

In cases of danger from over-administration of chloroform, prompt measures must be taken. Traction should be made upon the tongue. The doors and windows should be opened wide, so as to insure a current of fresh air. The chest and face should be flapped with a wet towel, and, above all, artificial respiration should be commenced at once. The head should be lowered and the extremities raised. A succession of quick, sharp blows over the thorax [and application of heat to the cardiac area] will sometimes stimulate the heart to action. Artificial respiration should be kept up steadily for some time, and a bystander, watch in hand, should see that the movements are not performed faster than twenty in a minute.

It must be remembered that, at a certain stage of chloroform anæsthesia, women sometimes exhibit marked signs of sexual excitement, and on their recovery it is not uncommon for them to bring charges of improper conduct against the bystanders. It is never safe, therefore, to give women an anæsthetic without the presence of a third person. The patient has no intention of bringing a false charge, but believes that impropriety actually took place.

Under the influence of chloroform and other anæsthetics, patients occasionally make use of bad language—a custom from which women are by no means exempt. A young lady brought up in the seclusion of a country parsonage may, when under chloroform, burst out with a torrent of oaths that would make a London cabby turn blue with envy. It is customary to say that the swearing is one of the symptoms of the drug.

In some instances a patient may have to be maintained under the influence of chloroform for a prolonged period —for hours, days, or, possibly, weeks. This has been done in the case of digital treatment of subclavian and other aneurisms. It presents no difficulty, for when once the patient is under the influence of the drug, a very few whiffs from time to time will keep him quiet. He may occasionally be roused sufficiently to take liquid food, or he can be fed by the rectum.

Patients have often been taken from London to Brighton under the influence of chloroform, and it is quite conceivable that, if necessary, they might be conveyed across the Atlantic in a state of insensibility.

Mortality from the administration of chloroform is comparatively high, and it is not unnatural that many patients look forward with a feeling of considerable dread to taking this anæsthetic. The choice of an anæsthetic is a serious one, and the question has been discussed as to who is to decide the point. Dr. Dudley Buxton thinks the anæsthetist should do so. He says: "Sometimes a patient refuses one anæsthetic, preferring another. Here the administrator clearly cannot shirk responsibility, but must give that agent which he deems best, without regard to the whim of the patient." Here I entirely differ from Dr. Buxton. I think the patient is the person to decide the question; assuming, of course, that he is in a condition of mind to be consulted. If a patient were to come to me, saying that he wanted chloroform for an operation, I would explain to him that ether is preferable ; but I should always recognize the fact that the ultimate decision rests with him. If I told my stock-broker to buy for me African mining shares, I would not be pleased if he invested the money in consols, even if they were safer.

There is sometimes a special reason, personal to the patient, for selecting one anæsthetic in preference to another. A young married woman, for example, may have heard that people talk pretty freely under the influence of ether, and, knowing that her husband will insist upon being present at the operation, she promptly decides to have chloroform ; being willing to take the increased chance of a fatal termination rather than the risk of saying something indiscreet in the presence of other people. It is inconvenient to rave about "dear Charley" when your husband's name is Edward. The lady knows best, and I should certainly respect her wishes in the choice of an anæsthetic.

Chloroform has many uses besides its employment as an anæsthetic in surgical operations. Although largely used in parturition, some people object to its employment on ethical grounds, believing that a woman should bring forth her children in pain and sorrow.[1] They hold this view when they are not in the family-way, but when it comes to the actual pinch, they generally arrive at the conclusion that just a little whiff would do no harm. The quantity of chloroform needed in these cases is very small, and there is no possible advantage in pushing it. A little vapor is inhaled, and the patient sinks into quiet sleep. Her sensibility to pain is decreased, but the uterine contractions go on as well as ever. On medical grounds there is no possible objection to the use of chloroform in these cases. It does not predispose to inflammation, post-partum hæmorrhage, or puerperal convulsions, and, in addition to the relief from pain which it affords, it is distinctly beneficial in relaxing the maternal passages. Then, again, chloroform is often given to relax spasm with the view of reducing dislocations and hernias. It is often given, too, as an aid to diagnosis, especially in suspected disease of abdominal organs, and in cases of malingering. It is used in the treatment of convulsions; in fits of all kinds, and is inhaled with advantage to allay the paroxysms of cough in pertussis, asthma, and phthisis. A spray of chloroform on the raw surface of an ulcer, or on large superficial burns, often relieves pain. A few drops, placed in the hand and held close to the eye, relieve photophobia. Mixed with lard, in the proportion of half a drachm to the ounce, it allays itching arising from urticaria or lichen.

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[1] [One of the wittiest rejoinders of which we have any account was that made by the Scotch doctor—this same Sir James Y. Simpson—to the patient whose objection to using chloroform in her approaching confinement was the one referred to by the author—*i.e.*,

> "*in sorrow thou shalt bring forth children.*"—GENESIS iii. 16.

"Well!" said Simpson, "if you have a mind to quote the Scriptures, you may remember that when Eve was *created*

> '*The* LORD *God caused a deep sleep to fall upon Adam, and he slept ; and He took one of his ribs, and closed up the flesh instead thereof.*'—GENESIS ii. 21.

"Now, there's *anæsthesia* for you !" said Simpson ; and it goes without saying that, in the matter of historical precedent, he not only had much the better argument, but he also showed a knowledge of authorities which most writers upon the subject appear to have overlooked.]

[A few drops on sugar, or mixed for a few moments with finely-powdered ice and then swallowed, will also relieve cough, and quiet an irritable stomach such as often attends an advanced stage of sea-sickness.]

[PREPARATIONS.—Emulsum Chloroformi, 4 per cent.; Linimentum Chloroformi, 30 per cent.; Spiritus Chloroformi, 6 per cent.; Aqua Chloroformi, 0.5 per cent.]

ETHER

[Æther, or Ether, is "A liquid composed of about 96 per cent., by weight, of absolute ether or ethyl oxide, and about 4 per cent. of alcohol containing a little water." Its specific gravity at 59° F. is 0.725 to 0.728; or at 77° F., 0.714 to 0.717. It should boil when a test-tube, containing some broken glass and half filled with it, is held for some time in the hand—*i.e.*, about 98.6° F. Its vapor is highly volatile and inflammable and, when mixed with air, is violently explosive.]

Observations made with Roy's apparatus, on the ventricle of the frog's heart, showed a marked difference between the action of ether and of chloroform. Whilst one or two minims of chloroform rapidly weakened and finally arrested the ventricle, fifty minims of anhydrous ether merely accelerated the beats and weakened them a little, the increased frequency more than compensating for the slightly diminished force of contraction.

Taking it all round, ether is a much better general anæsthetic than chloroform, for the reasons that it is much less dangerous; that it produces less vomiting, and that instead of depressing heart-action it acts as a stimulant to that organ.

When ether is used as a general anæsthetic it produces cyanosis; but the smallest admixture of air, by raising the mouth-piece, at once restores the color. It exerts no depressing effect on the heart, so that the anæsthetist has nothing to do but to look after the respiration.

In addition to its use as an anæsthetic, ether, in some form, is administered internally as an anti-spasmodic in the treatment of hysteria, flatulence, syncope, and asthma.

For producing general anæsthesia, it is given pure and without the admixture of atmospheric air. An ounce is poured into a cone, which may be made of sponge, leather, or pasteboard. It may first be dipped into hot water to warm it, if the weather is cold. It may have an india-rubber bag attached to the apex of the cone, so as to diminish waste.

As ether sometimes produces irritation of the larynx, and as the smell of ether is objectionable to some people, it is a good plan to give nitrous-oxide gas first, and then to follow it up with ether. A simple apparatus has been designed to enable the administrator to give, first nitrous-oxide, and then ether, without removing the mouth-piece. This, in the opinion of many administrators, is the best combination of anæsthetics which has yet been devised.

Etherization by the rectum has been suggested, but is best left alone. I have heard of a case (although I have not seen any published account) of a patient in private practice who was to have an operation for some slight laryngeal trouble. He was a man in good health, and it was determined to resort to rectal etherization. Soon after the commencement of the administration, the intestines became distended, the abdomen became tympanitic, and there was a profuse discharge of clear, watery fluid from the lungs. The patient died within an hour, practically on the operating-table. At the post-mortem examination it was found that the lungs were œdematous, and that the intestinal mucous membrane was markedly congested. I do not know what treatment was adopted; but a hypodermic injection of atropine would have checked the excessive secretion, and, possibly, have saved the patient's life. The administration of anæsthetics by the rectum seems to be undesirable, at all events when ether is employed.

For anæsthetic purposes ether is much less dangerous than chloroform; is less likely to produce vomiting and, instead of depressing the heart, acts as a cardiac stimulant. On the other hand, it is less suitable than chloroform as an anæsthetic for children; is not a good anæsthetic for people who suffer from bronchitis, and is unsuited for operations by gas or candle-light, or when the actual cautery is employed, owing to the inflammability of its vapor.

Moreover, ether makes people drunk, and people who are drunk tell their secrets.

Ether-spray is often employed as a local anæsthetic, its greatest value being in neuralgia and megrim. It may be used for the removal of small growths, small tumors, etc.; but it is not adapted, as a local application, for big operations. As a local anæsthetic it has some disadvantages: There is a good deal of pain when the part is being frozen, and there is still more pain when the thaw sets in. In exceptional cases it produces chilblains and even sloughing of the part.

[The customary details of ether-administration in the United States are somewhat different from those described by the author.

When anæsthesia is needed for a few moments only—as in opening an abscess—etherization is not required beyond its early effect, during which analgesia is produced for pain of moderate degree, without loss of consciousness or of much general sensibility. Commonly the patient is sitting, and sometimes holds the ether-cone with one hand while the other hand and arm are raised above the head. As the muscular sense diminishes, and the elevated hand trembles and drops, the incision is made. After a few moments the effects of the ether will have quite passed away.

For complete anæsthesia it is customary, as a preliminary precaution, and when practicable, to examine the urine and the condition of thoracic viscera, and, by the action of a purgative, to remove any distension of the abdomen by fæces or flatus that might interfere with movements of the diaphragm; to allow no food for several hours, other than a little tea or water and, perhaps, a little wine or whiskey, taken just before the ether is administered; and to avoid the presence of strangers—whether as assistants or as spectators—and any display of instruments and apparatus until anæsthesia is somewhat advanced.

Before inhalation is commenced, the nostrils, and the skin about the nose and mouth, are coated with petrolatum or ointment to protect them from the irritant action of ether—a matter of some importance as regards the future comfort of the patient, and also for the reason that any irritation of the nostrils is apt, with many persons, to produce more or less dyspnœa, in which cases there is more discomfort attending the early stage of anæsthesia. As an additional precaution against this particular feature, a little cocaine-spray in the nose is serviceable.

Some operators give a little chloroform—half a drachm or less—at first, to get over the early stage as quickly as possible, and then the ether.

The cone most used here is a clean towel, within the outer folds of which is a piece of clean, strong paper which is not very absorbent (to prevent evaporation). Into the apex of the cone a small sponge or wad of cotton-wool is packed and secured, to serve as a reservoir for the ether when it is poured into the cone.

At the outset the cone is not held against the face so tightly as to exclude some air; for it has been found that although a little more time is required, there is less resistance by the patient; and he escapes the fearful sense of suffocation which is never forgotten, and which often leads to much greater dread of anæsthesia than the mere loss of consciousness. When the reflex movements of the eyelids do not follow a touch of a finger-tip on the eyeball, anæsthesia is pretty well established.

If, at the first, the patient does not inhale deeply, or holds the breath, a little encouragement to talk will generally help matters. When the stage of excitement comes on, there should be sufficient assistance at hand to hold the limbs and keep the patient on the table during the few moments of its duration; for if, by chance, the patient gets to the floor, and etherization is interrupted, there may be more fighting than is desirable, especially if the patient should be a strong male, and there are knives near by.

Ether commonly excites a flow of saliva and naso-pharyngeal mucus sufficiently to interfere with breathing, if the etherization is of some duration. Therefore a clean, soft towel, or a few swabs of absorbent-cotton, should be provided, and it is a good plan to have, in a handy pocket, a bottle-cork with a string attached, which can be put between the patient's teeth if required to save the fingers of the attendant and facilitate use of the cotton swabs.

Vomiting sometimes occurs toward the end of anæsthesia, and a basin and towels should be within reach; but when the precautions above mentioned have been used, it is rare.

In the Medical Record of October 12th, 1895, Dr. Carter S. Cole, of New York, gave an account of the method which he and Dr. Francis H. Markoe had recently used (at the suggestion of Mr. J. Preston Carson—a chemist), consisting of the administration of a mixture of ether and oxygen. The details can best be acquired from the original paper, but may be briefly stated here:

The time required to obtain complete anæsthesia was decidedly lessened; so, too, was the period of recovering consciousness. Salivation was practically abolished. Vomiting caused less trouble than when ether alone is employed, and, in the large majority of cases, there was not even nausea at any time. Increasing the proportion of oxygen increased heart-action, and *vice versa*. Respiration was easy, and there was no struggling and no suffocation. Instead of the cyanosis which usually occurs, and which is very intense at times, the color of the face was excellent, and in no case was any "blueing" observed. Finally, it may be said, the consumption of ether was greatly lessened, and it was rare that the odor of ether could be perceived in the room.

Subsequent reports by other operators warranted the belief that this method is a most valuable improvement upon those heretofore in vogue.]

[PREPARATIONS.—Spiritus Ætheris, 32.5 per cent.; Spiritus Ætheris Compositus, 32.5 per cent.]

[illegible]

[illegible]

[illegible] anesthetic for [illegible] gas, which [illegible] For an- [illegible] in steel [illegible] pro- [illegible] pure. [illegible] anesthesia is [illegible] the blood. [illegible]

[illegible] a sharp [illegible] It [illegible] one [illegible] It is safer to [illegible] administ- [illegible] successive days if

[illegible] oxygen in [illegible] anesthetic, and [illegible] the combination

[illegible] in the man- [illegible] are intermediate [illegible] Its odor is gene- [illegible] has the advantage [illegible] used both in major [illegible] soon pass off on [illegible] being very little [illegible] doses it exerts [illegible] being identical [illegible] form. It seems probable, from observations made with Roy's apparatus, that on the ventricle of the frog's heart ethidene dichloride acts not only in the same way as chloroform, but in an equal degree. The depressing action of the anæsthetic in both cases is readily antagonized by the addition of a small dose of ammonia.

Ethidene dichloride was the favorite anæsthetic with the late Mr. Clover, who gave it in nearly two thousand cases. He usually gave nitrous-oxide first, and then went on with the ethidene. The patient usually falls asleep without moving a limb; there is a little convulsive twitching followed by stertorous breathing. The pupils dilate with the onset of stertor; but if a little air is admitted with every third or fourth respiration, they rapidly contract. Under the influence of the drug, dreams are generally pleasant, and the patient often thinks that he is travelling rapidly to the accompaniment of soft music. When he awakes it is as if from natural sleep, and he can talk clearly and walk without difficulty. In giving ethidene it is necessary to watch the pulse, and to remember that it cannot be given with the same freedom as ether.

Ethidene has lost ground as an anæsthetic, and no longer occupies the place it once did in popular favor.

"A.C.E." MIXTURE

The "A.C.E." mixture was originally introduced by Dr. George Harley. It consists of 1 part of alcohol, 2 parts of chloroform, and 3 parts of ether. Its action is midway between that of chloroform and ether. It is a good anæsthetic and is fairly safe, but not so safe as ether.

There are many other mixtures in which chloroform and ether, or alcohol, chloroform, and ether, are combined in various proportions.

The substance known as

Methylene was originally introduced as a simple substance, but it seems probable that in reality it is a mixture of methyl alcohol (wood spirit) and chloroform.[1]

There are a great number of combinations which can be employed as anæsthetics in surgical operations, and in the hands of an expert good results can be obtained with any of them. It must be remembered that every anæsthetist has some one favorite anæsthetic, and, from constant practice, he gets to know the behavior and capabilities of his agent, so that he becomes a specialist or expert in its employment.

IODOFORM

Iodoform is made by the action of iodine on a mixture of alcohol and a solution of carbonate of potassium. It is met with in two forms: a crystalline, lemon-yellow powder, which is the official variety; and precipitated iodoform, an impalpable powder. The crystalline form is usually preferred by surgeons, as it does not cake; but the precipitated form is less irritating, and is more commonly employed for dusting on sores.

ACTION.—Iodoform is an antiseptic and deodorizer.[2] It is a powerful local anæsthetic, but produces no local irritation.

In frogs, it weakens action of the heart, exerting a powerful paralyzing action on the cardiac muscle. Experiments with Roy's apparatus on the ventricle of a frog's heart, with a one-per cent. alcoholic solution, show that it is a much more powerful cardiac depressant than even chloroform. It was found that one-fifth of a grain arrested action of the ventricle, whereas it required two minims of chloroform, weighing about a grain and a half, to produce this result. The action of iodoform on the heart is promptly antagonized by ammonia, only to be reproduced by the application of a further dose of ammonia. This may be repeated many times, affording a complete demonstration of the mutual antagonism of the drugs on the frog's ventricle.

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[1] [Merck defines this as "Methyl Bichloride, so-called Ricardson," consisting of 1 volume of methyl alcohol and 4 volumes of chloroform. It is also added, as precautionary, that it is not to be confounded with *Methylene* Bichloride or Dichloro-methane.]

[2] [Of an English medical student it is told that, in answer to a request by his professor that he would define the action of an antiseptic, he said (probably having iodoform in mind): "It stinks so badly that windows are opened to get fresh air."]

In man, it sometimes acts as a soporific. The case is recorded of a patient who was ordered a gramme of iodoform for application to a chancre. He used it on going to bed, and, failing to replace the cork in the bottle, the contents were scattered over the sheets. The room was small and the night was hot. The patient passed into a deep slumber, from which he was aroused, with much difficulty, some twenty-four hours later. His clothes and breath smelt strongly of iodoform during the whole of the following day.

In another case a patient took seventy-five grains of iodoform in pills, in the course of a week. Somnolence supervened, the gait became unsteady, and there was pain over the entire circumference of the head. After this condition had lasted for a day a comatose condition ensued, which persisted for five days, the patient, however, taking nourishment without difficulty.

In still another case a patient took ten and a half drachms of iodoform in pills, in eighty days. At the end of this time vertigo, weakness, and double vision were noted. These symptoms lasted two and a half days, and were followed by sleepiness, alternating with excitement and incoherence of speech, which persisted for twelve days.

Binz is of opinion that this comatose condition is due to the liberation of iodine in the system, the iodine acting on the brain-cells in such a way as to inhibit their functions.

In surgical practice, cases of iodoform-poisoning are not of uncommon occurrence, especially when the drug is employed in large quantities. The most common symptoms are slight nocturnal delirium, drowsiness, progressive emaciation, high temperature, and rapid pulse. In some instances the temperature has risen to 105.8° F., and the pulse to 150 in the minute. The patient becomes languid, complains of dizziness and mental confusion, and finally relapses into a lethargic condition. There may be paralysis of the sphincters, and death may occur suddenly. The most dangerous symptoms are those associated with disturbance of cerebral functions.

When iodoform is used in large quantities as a packing for cavities, in injuries to the joints, or in open wounds, it may act as a foreign body; becoming, in process of time, incorporated with newly-formed connective-tissue, in which it may remain encapsuled after completion of the healing process. In such cases it usually makes its presence felt by giving rise to an "iodoform-abscess," the existence of which is indicated by circumscribed swelling. The contents consist of pure iodoform mixed with a little mucus.

When applied freely to a wound or deep sinus, iodoform cannot be removed by simply washing with water, and oil of eucalyptus is commonly used as a solvent.

Symptoms of iodoform-poisoning are most likely to occur when the drug is employed in conjunction with carbolic acid, the carbolic acting on the kidneys and rendering them temporarily incapable of eliminating the iodoform. There is no advantage in employing iodoform in large quantities, as its antiseptic effects are amply secured by smaller and non-toxic doses, and, in the case of wounds, by simply dusting it on the surface from a dredger.

When used in the form of a suppository it produces anæsthesia, so that the patient defecates without his knowledge.

Iodoform is split up in the blood, and iodine appears in the urine in the form of iodide of sodium.

The characteristic odor of iodoform is, to some extent, masked by the addition of Tonquin bean. Half a drachm of oil of sandal-wood, mixed with an ounce of ointment containing a drachm of iodoform, will effectually mask its odor without impairing its efficacy. Iodoform is soluble in a saturated alcoholic solution of camphor, and this also covers the smell.

As a local application, iodoform is a specific for the soft chancre, and since its introduction this form of sore has practically ceased to be an active factor in the life of the surgeon. It is useful in all other forms of suppurating ulcer due to venereal poisoning. Whether the sore be indurated or not, if there is ulceration and a discharge, iodoform will invariably put an end to them. If there is induration, the sore remains hard in spite of it, but it becomes clean and heals. In many forms of tertiary syphilis, it is of the greatest value. In the tertiary syphilitic ulcers of inherited syphilis, it is surprisingly efficient. In all forms of phagedenic action it should be resorted to without delay. In the treatment of gonorrhœa, bougies composed of iodoform and oil of eucalyptus are employed.

Dr. Foxwell, of Birmingham, who has had considerable experience in the internal administration of iodoform, regards it as almost a specific for phthisis. He gives it in one-grain pills, six times a day, and finds that it gives better results than any other drug or combination of drugs with which he is acquainted. It soothes the nervous system of erethitic subjects ; lessens cough and expectoration ; powerfully stimulates nutrition, and markedly improves the condition of physical signs. One of his patients took fifty grains a day without inconvenience, and another took from twenty to thirty grains a day, for two years and a half, with no detectable ill-effect. It would appear from these observations that iodoform exerts as marked an influence on phthisis as mercury does on syphilis. Dr. Foxwell did not meet with the comatose condition, described by other writers as the result of the employment of large doses.

It would seem probable that, in these cases, the drug acts as a pure antiseptic, and not by virtue of the iodide of sodium into which it must be converted in the blood. I have employed the iodoform-treatment in a large number of cases, both of phthisis and winter-cough, and although, in the main, I confirm Foxwell's treatment, I have met with several cases in which the employment of large doses had to be abandoned on account of the nausea and vomiting resulting from the administration of the drug, and the powerful odor it imparted to the breath.

Iodoform is conveniently made into pills with sugar of milk and glycerin of tragacanth.

For insufflation in cases of laryngeal phthisis, the following is an excellent powder:

Powdered Iodoform,	ʒ ij.
Powdered Boric Acid,	ʒ ij.
Menthol,	gr. x.
Powdered Phosphate of Lime	to ℥ j.

An useful antiseptic powder, sometimes known as Cavazzini's, is made as follows:

Iodoform,	55 parts.
Salicylic Acid,	20 "
Subnitrate of Bismuth,	20 "
Camphor,	5 "

It has an agreeable odor and is not irritating. It is employed externally.

An iodoform ointment, useful in the treatment of indolent or foul smelling wounds or ulcers, is made as follows:

Iodoform,	ʒ i.
Oil of Eucalyptus,	℥ i.
Soft Petrolatum,	
Hard Petrolatum,	āā ℥ ijss.

[PREPARATION.—Unguentum Iodoformi, 10 per cent.

CONGENERS with iodoform are several substances having somewhat analogous effects, but less offensive as regards their odor. Of these, **Aristol**, otherwise known as annidalin or diiodo-dithymol, is probably most used. It is a bulky, reddish-brown powder, having but slight odor. It is more expensive than iodoform but, considering the small amount of either which is requisite, this need not be a serious objection.

Creolin, a dark-brown, syrupy liquid of tar-like odor, is composed of homologues of carbolic acid, water, hydrocarbons, organic bases, sodium, resin, sulphur, and chlorine. It is recommended as a non-poisonous substitute for carbolic acid; as a germicide and deodorizer; having the power, it is said, of removing the odor even of iodoform.]

CHLORAL HYDRATE

This substance, often called chloral, was introduced into medicine in 1869, by Professor Oscar Liebreich, of Berlin. He found that it was decomposed by alkaline solutions into formic acid, which combined with the alkali, and chloroform. He thought that it would be split up in the same way by the alkalinity of the blood, and would be useful as an anæsthetic. There is reason to suppose that this theory is incorrect. In animals poisoned with chloral hydrate, chloroform cannot be detected in the blood, excreta, or breath ; whereas in animals poisoned with chloroform itself, its detection is by no means difficult. It has also been shown that in the "salt-frog"—in which the blood is replaced by a saline solution—chloral hydrate produces its characteristic effects. The expired air of chloralized animals contains no chloroform, and all the evidence points to the fact that chloral hydrate is not split up into chloroform in the blood.

ACTION.—The pulse, when only a moderate dose is taken, remains unaffected, or is rendered only slightly slower. The pupils are contracted, but become normal as soon as the patient awakes. When larger doses are taken, sleep is more profound and may pass into coma. The respirations fall in number. The pulse is weakened and rendered slower, but may become rapid and irregular if the dose amounts to a toxic one. The muscular system is relaxed, and both sensibility and reflex action are diminished.

After large doses of chloral hydrate the blood-pressure is much lessened, and this is due, in part, to vaso-motor paralysis, but still more to the depressing action of the drug on the heart.

If a fatal dose has been taken, all these symptoms are intensified. There is coma with intense muscular relaxation, the pulse is weak and thready, the pupils are at first contracted and then dilated, the respiration is shallow, and there is well-marked paralysis.

Slowing of the pulse is not due to the action of the drug on the vagus, for it occurs after section of that nerve and after it has been paralyzed by atropine. The stoppage of the heart is due to paralysis of the cardiac ganglia, as the heart contracts readily when its muscular substance is stimulated directly.

The paralysis is due to direct action of the drug on the spinal cord. Chloral hydrate acts first on the gray matter of the cord, and impressions which are usually painful, are unperceived at a stage when tactile impressions still produce reflex movements. In cases of poisoning, the heart is arrested in diastole. The arrest is not muscular in origin, but is due to influence of the drug on the centres at the base of the brain.

One of the most characteristic actions of the drug is the fall in temperature induced by large doses. It may fall as much as seven degrees, and it is not uncommon for it to fall until it can no longer be measured by the clinical thermometer. An animal which would die from a certain dose of chloral hydrate, can be kept alive if wrapped in cotton-wool so as to maintain its temperature.

Chloral hydrate is excreted with the urine unaltered, so long as the urine is acid; but when the urine is alkaline, it is partly decomposed into chloroform.

In exceptional cases, chloral hydrate, even in medicinal doses, produces irritation of the conjunctivæ. The "chloral-rash," like many medicinal rashes, assumes various forms: It may be an erythema, scarlatiniform in appearance and followed by desquamation; or it may be an urticarial rash, or an eczema. It is rarely persistent, and disappears without treatment. It may be accompanied by fever; but it would be unwise to give quinine to reduce the temperature, as the case might be complicated by the appearance of a quinine-rash.

Summing up the action of chloral hydrate, it may be said that it acts upon the cerebrum as a powerful and certain hypnotic; that it acts as a depressant to the centres at the base of the brain; that it depresses the functions of the spinal cord; and that it produces slowness and weakness of the heart's action, vaso-motor paralysis, and muscular weakness with anæsthesia. In fatal doses, it causes death by arresting, through paralysis of the nerve-centres, first respiration and then the heart, which stops in diastole. It exerts no influence on the vagus, and none on the motor nerves.

Chloral hydrate is most closely allied in action to paraldehyde, and is antagonized by strychnine and members of that group, and, to some extent, by picrotoxin.

The custom of taking chloral hydrate as a nerve-sedative seems to be steadily on the increase. Many ladies never think of travelling without it, and resort to a dose of the syrup on the slightest provocation. Many of these people are excessive cigarette-smokers and indulge freely in alcohol, so that it is difficult to say how much is due to chloral hydrate and how much to other disturbing influences.

The symptoms of "chloralism" are:

Digestive troubles, probably due to direct action of the drug on the mucous membrane of the stomach.

Dyspnœa, which may be slight, and experienced only on exertion, or may be persistent and alarming.

Skin eruptions, usually urticarial in character, although they may assume the form of petechiæ or ecchymoses.

Ulceration about the nails is not uncommon.

The patient exhibits an excited, hurried manner ; is voluble in speech, and suffers from vertigo, wakefulness, and depression of spirits.

Enfeebled nerve-power and weakened mental activity.

It is probable that the habitual chloral-eater is not fully responsible for his actions. It is said that a sudden withdrawal of the drug will induce a condition allied to delirium tremens, and it has certainly been known to induce a mental condition in which the patient is temporarily irresponsible for his acts.

THERAPEUTICS.—When chloral hydrate is given to a patient it induces quiet sleep, closely allied to natural sleep, generally calm, refreshing, and dreamless, and not too profound to prevent coughing, or to interfere with taking food. A patient aroused from a chloral-sleep will take nourishment, and then lie down and sleep again. Sleep, after an ordinary medicinal dose, may come on in a few minutes, or may be postponed for half an hour. The dose should always be given when the patient is actually on the point of retiring to rest, and he should remain quiet and avoid excitement, or it may produce restlessness instead.

The sleep induced by chloral hydrate is due partly to the direct action of the drug on the brain, and partly to contraction of the blood-vessels supplying that organ. It first congests the retina, but subsequently contracts the vessels so that the retina assumes a pale pink color.

The after-effects are usually slight ; sometimes it produces, on the following morning, a good deal of heaviness and sleepiness, and, occasionally, frightful dreams, excitement, intoxication, and delirium. As a general rule, however, it causes no giddiness, headache, nervous depression, constipation, sickness, nor loss of appetite.

Chloral hydrate should not be administered with alkalies.

BUTYL-CHLORAL-HYDRATE

This substance, also introduced into medicine by Oscar Liebreich, was originally known as croton-chloral. Its chief characteristic is that it produces anæsthesia of the fifth cranial nerve and of the parts supplied by it.

In large doses, it has much the same action as chloral hydrate, although it has a less depressing action on the heart. It is largely employed in the treatment of facial neuralgia, and in cases of megrim and hemicrania.

It is often given in neuralgia in combination with gelsemine, the following being a useful mode of administration :

Butyl-chloral-hydrate,	gr. iij.
Hydrochlorate of Gelsemine,	gr. $\frac{1}{200}$
Glycerin of Tragacanth,	gr. ss.

To make a pill. One to be taken every four hours.[1]

PARALDEHYDE

Paraldehyde is a clear, colorless fluid, which was introduced as a substitute for chloral hydrate. It has a characteristic, ethereal taste, and is usually given in doses of from half a drachm to a drachm and a half, with simple elixir [or, when bulk is desirable, in an equal quantity of almond oil].

It is rapidly absorbed, and produces its effects quickly ; and is eliminated by the lungs, its odor being detected in the breath twenty-four hours after the last dose was taken.

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[1] [Pharmaceutists might object to this formula on account of the difficulty of forming, with the glycerin of tragacanth, a pill-mass which would enable them to feel assured that each pill contained, even approximately, $\frac{1}{200}$ of any ingredient. By first triturating the alkaloidal salt with a proper quantity of sugar of milk, for example, until it is perfectly subdivided and mingled with the sugar, a pill might afterward be formed ; but it would probably be larger than would please the prescriber. As a general practice, it would, perhaps, be well to give very active remedies, like the above-named, in solution, were it not that many alkaloidal salts are rapidly decomposed in the presence of fungous growths, to which such solutions are liable. However, the use of chloroform-water will commonly render the solutions reasonably permanent.]

It may give rise to dyspepsia, nausea, and free perspiration.

In cases of poisoning, the treatment would be the same as for chloral hydrate.

The following formula is offered tentatively as a convenient mode of giving this drug :

Paraldehyde,	℥ ss.
Tincture of Vanilla,	♏ xx.
Alcohol,	℥ ss.
Syrup,	℥ j.
Water,	to ℥ iv.

A tablespoonful at bedtime.

It is sometimes given in the form of an emulsion :

Paraldehyde,	℥ ss.
Oil of Gaultheria,	♏ xv.
Powdered Gum Acacia,	ʒ ij.
Syrup of Wild-cherry,	℥ j.
Water,	to ℥ iv.

A teaspoonful, in water, every four hours.

The reports of its action, received by the Therapeutic Committee of the British Medical Association, were, on the whole, favorable ; but no one seemed to be particularly enthusiastic about it.

SULPHONAL

Sulphonal was discovered by Professor E. Baumann, of Freiburg, and its physiological properties were investigated by A. Kast, who, in 1888, gave an account of its action. Its chemical name is diethyl-sulphone-dimethyl-methane, and it is an oxidation-product of the union of ethyl-mercaptan with acetone. It is met with in the form of colorless, inodorous, and nearly tasteless crystals.

Sulphonal is most closely allied in physiological action to trional and tetronal. Sulphonal contains only two ethyl groups in its molecule, trional (diethyl-sulphone-methyl-ethyl-methane) contains three, whilst tetronal (diethyl-sulphone diethyl-methane) contains four.

Therapeutics.—[The principal use of sulphonal is for the production of sleep.] It is not altogether a harmless substance. It may produce giddiness, ataxic movements, and loss of motor power in the legs. Patients, after having a dose, not uncommonly complain of being unable to stand, and say that they cannot walk properly. They present the appearance of being drunk, and tumble about in an unsteady and unpleasant manner. Sometimes they develop a skin-eruption.

When sulphonal is administered continuously for some weeks at a time, there is gastro-intestinal disturbance, vomiting, and constipation; with—from time to time—swelling of the joints, pain in the lower extremities, failure of coordination, scanty secretion of urine, and other symptoms.

It is given in doses of from fifteen to forty grains, either in hot beef-tea, or in brandy and water. It is absorbed slowly, and should be given a couple of hours before the soporific influence is required, [and should be given with much caution when the kidneys are not acting properly].

NITRITE OF AMYL

Amyl Nitrite is made by the action of nitrous acid on amyl alcohol. It is a yellow, ethereal fluid, having the odor of Jargonelle pears, [and is very volatile and inflammable]. It rapidly deteriorates by keeping, and becomes stale. It is often put up in the form of glass capsules; but these have no particular advantage over specimens of the drug kept in ["small, dark, amber-colored and glass-stoppered vials, in a cool and dark place, remote from lights." —U. S. Pharm.].

Action.—When inhaled, it flushes the face, induces perspiration, accelerates the pulse, and causes the heart to beat strongly, producing a sensation as if the head were full to bursting.

Dilatation of the arteries is due to paralysis either of the muscular walls of the arterioles themselves, or of the vaso-motor ganglia. The paralyzing effect on the arterial-system is sufficiently indicated by sphygmographic tracings, by flushing of the face, and by increase in size of the visible arteries—such as the temporal.

The loss of reflex action observed in the lower animals is due to depression of the motor-tracts of the cord.

The action of nitrite of amyl on the blood has been fully investigated by Dr. Arthur Gamgee. It gives rise to the formation of methæmoglobin, the blood, in both the arteries and veins, assuming a chocolate-brown color and yielding brown hæmoglobin crystals, which probably consist of methæmoglobin. Oxidation in the body is interfered with to a marked degree, so that, in rabbits, convulsions closely resembling those of asphyxia are induced.

This action of nitrite of amyl on the blood is shared by other nitrites, such as the nitrites of potassium, sodium, and silver, and may be briefly summarized as follows:

The nitrites produce a peculiar change in the color of the blood and in the absorption-spectrum, due to the formation of compounds presenting the same crystalline form, color, and spectrum, whatever nitrite is employed. These bodies are compounds of the nitrite with oxidized hæmoglobin, and, although isomorphous with hæmoglobin, they differ from it in their power of absorbing oxygen. The addition of nitrites to hæmoglobin results in the locking up of the loosely-combined oxygen, so as to render it irremovable by carbonic acid or by a vacuum.

Temperature is lowered by arrest of oxidation, and, in the case of animals, sugar appears in the urine, probably as a result of local disturbance of blood-pressure in the liver.

It has been found that, after inhalation of nitrite of amyl, many people see everything yellow, the yellow area or spot being surrounded by a halo of violet-blue with undulating rays at the circumference. This yellow vision disappears only after some minutes, becoming paler little by little. There may be an impairment of the acuteness of vision, so that difficulty is experienced in distinguishing the figures of a large clock, which present a blurred appearance.

In some cases, after the inhalation of only a few minims, the patient suffers from vertigo, headache, and even temporary mental aberration. Women often become hysterical and burst into tears. A more serious symptom is the occurrence of collapse associated with fainting, weak pulse, and a cold, clammy condition of the skin. Many patients suffer so severely from even a small dose of the drug that they are unwilling to repeat the experiment.

THERAPEUTICS.—The chief use of nitrite of amyl is for relieving the paroxysms of angina pectoris. It should be inhaled, and the best plan is to pour a few drops on the palms of the hands or on a pocket-handkerchief. Pharmacists are very fond of selling nitrite of amyl in glass capsules which are intended to be broken; but there is no possible advantage in this arrangement, for nitrite of amyl is not a substance the use of which requires to be regulated with any particular care. The most convenient plan is for the sufferer from angina pectoris to carry one or two drachm-bottles of the drug in his waistcoat pocket. It is always ready for use, and it avoids the trouble of breaking a glass capsule. The great point to remember about nitrite of amyl is that it gets stale by keeping, so that the bottles must be replenished every third or fourth day.[1]

Nitrite of amyl would probably act well if given internally in brandy; but it is not absorbed so quickly as when taken by the lungs, and in a severe attack the patient is anxious to obtain relief as speedily as possible.

In addition to its use in angina pectoris, nitrite of amyl has been given with some success in the treatment of asthma, megrim, and Bright's disease.

Nitrite of amyl has no lethal action. Some years ago a bottle of nitrite of amyl was upset over the bed of a paralyzed woman. The nurses fled from the room and, on returning some time later, were surprised to find the patient quite unaffected and anxiously inquiring what was the matter. Dr. E. R. Squibb, the American chemist, by accident broke a flask containing about two pints of nitrite of amyl, which ran over the table and floor of the room. It was necessary to turn out several gas-burners which were alight, so that he was exposed for some minutes to a very concentrated vapor. The effect of the drug was decidedly stimulating; but he experienced no ill-effects and did not lose consciousness. A patient of mine, suffering from angina pectoris, was ordered a bottle of nitrite of amyl to inhale during his paroxysms, and some cough linctus. Being disturbed during the night, he reached out of bed for his cough-medicine, and took a mouthful of the amyl by mistake. In a few minutes it was rejected by vomiting, when, finding the room was rather oppressive, he put on his clothes and went to the front door, where he found the other members of the household assembled in scanty attire, the smell of the drug having disturbed their slumbers.

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[1] [Dr. H. G. Piffard, of New York, proposed filling the pocket-vial with absorbent-cotton, loosely packed. This holds the amyl nitrite in case the stopper becomes loose, and prevents its accidental loss.]

NITROGLYCERIN

Nitroglycerin was discovered in 1847 by Sobrero. It is commonly prepared by what is known as Liebe's process: Half an ounce of dehydrated glycerin is poured, with constant stirring, into a mixture of two ounces of sulphuric acid and one ounce of fuming nitric acid of specific gravity 1.52, the temperature of the mixture being kept below 25° C. (77° F.) by external cooling with ice. As soon as oil-drops begin to form on the surface, the mixture is poured, with constant stirring, into fifty ounces of cold water. Nitroglycerin then separates, and may be purified by washing and drying, in small quantities, in a vapor bath. The greatest care must be taken in the process, the glycerin being added drop by drop, and the temperature carefully noted by means of a thermometer. The nitroglycerin thus obtained must be well washed to free it from traces of acidity. It appears first as a white, opaque, milky-looking, oily fluid, but, on careful drying by exposing it in a warm room in flat dishes containing thin layers, it becomes dehydrated and forms a transparent, colorless, oily fluid. It is slightly soluble in water, and dissolves freely in alcohol, ether, fats, and oils. It is, although slightly volatile, inodorous, and has a sweet, pungent, aromatic taste. It crystallizes or freezes at low temperatures. It is largely employed as an explosive in mining and blasting operations (being fired by percussion), and forms the basis of compounds known as dynamite, glyoxylon, dualin, etc. When boiled with potash, it decomposes; glycerin and nitrate of potash being formed. Matthew Hay maintains that nitroglycerin is really a nitrate of glyceryl, and not a nitrite.

Although nitroglycerin is official, in the sense of there being an official preparation of the drug [entitled spirit of glonoin, having a strength of one-per cent.], no directions are given in the Pharmacopœia for its manufacture. The omission is dictated by considerations of [personal and] public safety—it being considered unwise in such a work to lay down rules for making so dangerous an explosive.[1]

THE ACTION of nitroglycerin on the lower animals has been investigated both in this country [England] and on the Continent. A dose of six minims of a ten-per cent. solution, injected under the skin of a frog, produced, among other symptoms, languor, tetanus, and finally paralysis. Immediately after the injection the animal became restless and the respirations very rapid. In a minute or two this restlessness subsided and gave place to lethargy, the frog showing a disinclination to move. Respiration continued rapid and, in about five minutes from the commencement of the observation, the animal gave a sudden spring and fell into tetanic convulsions. These lasted about half a minute and then passed off; they soon returned, however, and were readily excited by touching the animal. After continuing for some time they gradually became weaker, and the animal died. In some instances the mouth seemed to be the part first affected by the convulsions, as the jaws were seen to open and shut; but, possibly, this action was connected with respiration rather than with the general convulsions. Next it spread to the forward limbs, and finally to the hind ones. It was noticed, too, that the fore limbs were more sensitive than the hind, as slight spasmodic twitches could sometimes be produced by touching or pinching the former, when similar irritation of the latter had no effect.

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[1] [It has been well established that the one-per cent. spirit is not in the least explosive.]

To ascertain whether tetanus was due to the action of the drug on the spinal cord, or on the nervous centres within the encephalon, the spinal cord was cut across before the poison was given. The upper part of the animal immediately became very restless, the fore limbs were outstretched with the toes spread out; but there was no alteration in the hinder part of the body or in the hind limbs. This result was confirmed by another experiment: A frog was decapitated and, after the spinal cord had recovered from the shock and reflex movements were again observed, the drug was injected, but no spasm occurred. It is probable that the tetanus is not due to any action on the cerebral lobes, but to the effect of the poison on the optic lobes.

The principal effects produced on cats by nitroglycerin are great acceleration of respiration, paralysis, loss of reflex action and sensibility, and death from arrest of respiration. It is recorded that a dose of about sixty minims of a ten-per cent. solution, having been injected into the peritoneal cavity of a cat, there was observed, in a few minutes, stretching movement of a hind leg, as if the animal were trying to shake something off the foot. Half an hour later the animal vomited and, at the expiration of about an hour (during which the legs seemed to fail in walking), it sank down, never to rise again. Vomiting occurred again once or twice, breathing became very rapid, and the tongue was drawn backward and forward as in a dog that has been running. Slight, spasm-like hiccough then set in and, five minutes later, the animal was dead—a little over two hours after injection of the poison. The loss of reflex action noticed in observations on frogs and cats in the advanced stages of poisoning, indicate that the cord is paralyzed ; and, from persistence of reflex action in parts supplied by the cranial nerves, after its disappearance from other parts of the body, it would seem that the spinal cord is paralyzed before the ganglia at the base of the brain.

Nitroglycerin dilates the blood-vessels in much the same way as nitrite of amyl ; but its action is much more persistent. Nitroglycerin does not flush the face (or only to a very slight degree) ; but it produces most persistent headache. Some people are much more susceptible to the action of the drug than others, the merest contact with a specimen being sufficient to induce in them headache of many hours' duration.

The effects of nitrite of amyl and of nitroglycerin on the pulse are similar. Both drugs produce a marked state of dicrotism, and both accelerate rapidity of the heart's action ; they differ, however, in the time they respectively take to produce these effects. The full action of nitroglycerin is not observed in sphygmographic tracings until six or seven minutes after the dose has been taken. In the case of nitrite of amyl the effect is obtained in from fifteen to twenty seconds after an inhalation, or after a dose has been taken on sugar.

The influence of nitrite of amyl is extremely transitory, a tracing taken a minute and a half after exhibition of the drug being perfectly normal. In fact, the full effect of the nitrite on the pulse is not maintained for more than fifteen seconds.

Nitroglycerin produces its effects much more slowly than amyl nitrite; they last longer and disappear gradually, the pulse not resuming its normal condition for nearly half an hour. The effect may be maintained for a much longer time by repeating the dose. Nitroglycerin is more lasting in its power of producing a dicrotic form of pulse-beat, and, consequently, in cases where the conditions of relaxation and dicrotism are desired to be maintained for some time, its exhibition is to be preferred to that of nitrite of amyl.

Nitroglycerin increases the secretion of urine. I made some observations on this point on an epispadiac. The quantities of urine passed were: during the first and second quarter-hour of the observation, 2¾ drachms each. Fifteen minims of a one-per cent. solution of nitroglycerin were then given in a drachm of water, and in each succeeding quarter-hour the quantities were: 12, 16, 16¾, 8¾, 5¾, and 3 drachms, respectively.

In another observation on the same person, the following figures were obtained: first quarter-hour, 4 dr., pulse 64; second quarter, 10 dr., s. g. 1003, pulse 64.

Twenty minims of a one-per cent. solution were then given, in a drachm of water, and during the succeeding periods of a quarter-hour the results were:

7 oz.: s. g. 1000, pulse 80—7½ oz.: s. g. 1000, pulse 76—1 oz: s. g. 1002, pulse 72—7 dr.: pulse 68—4½ dr.: pulse 64.

The acidity of the urine varied inversely as the quantity passed. Thus, before the administration of the drug it was distinctly acid, during the third and fourth quarters it was almost neutral, acidity then gradually returned, till, in the seventh quarter, it was as marked as it had been at first.

THERAPEUTICS.—Nitroglycerin is largely used in the treatment of angina pectoris. It promptly relieves the paroxysms of pain. It is almost impossible to lay down definite rules with respect to the dose. It is best to begin with one two-hundredth of a grain, but the dose can be gradually increased, and many patients take a grain without inconvenience.

A good formula for the administration of nitroglycerin in cases of angina pectoris is the following:

Nitroglycerin,	gr. $\frac{1}{100}$
Nitrite of Amyl,	gr. $\frac{1}{4}$
Menthol,	gr. $\frac{1}{50}$
Capsicum,	gr. $\frac{1}{100}$

This may be made into a tablet, or pill, and coated. The object is to get rapid absorption, so that immediate relief may be given, and this is facilitated by the introduction of the menthol and capsicum.[1]

Dr. P. M. Mikhalkine, of Nijnii-Novgorod, maintains that nitroglycerin is one of the best remedies for sciatica, and says that it often succeeds in effecting a cure after the failure of antipyrin, phenacetin, acetanilide, and other drugs.

His formula is:

Spirit of Glonoin,	Gm. 5.0
Tincture of Capsicum,	Gm. 7.5
Peppermint Water,	Gm. 15.0

The dose is from five to ten drops, three times a day.

NITROUS ETHER

Spiritus Ætheris Nitrosi is the substance popularly known as sweet spirit of nitre. It has been used as a medicine since the beginning of the thirteenth century, but our knowledge of its physiological action is due to the careful observation of Professor Leech, of Manchester. It is defined as ["An alcoholic solution of ethyl nitrite, yielding, when freshly prepared, and tested in a nitrometer, not less than eleven times its own volume of nitrogen dioxide."—U. S. Pharm.].

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[1] [Aside from the uncertainty of dosage when such small quantities are to be administered in the form of a pill, it is also questionable whether the solubility of a pill-coating can always be assured; at least with sufficient certainty as to make its use expedient when very prompt effects are wanted.]

Action.—Spirit of nitrous ether is a distinct depressor of arterial-tension, and it exhibits properties similar to those which have been observed in the case of nitrite of amyl, nitroglycerin, and nitrites of the alkali-metals. It produces a sense of fulness in the head, rapid action of the heart, and a suffusion of the skin. The action on the blood is similar to that of nitrite of amyl. After a full dose the sphygmographic pulse-trace invariably indicates a marked fall in arterial-tension, and this decreased tension lasts for two or three hours. The action of the drug on the kidneys is similar to that of nitroglycerin, and it induces an increase in the amount of urine passed.

The physiological action of nitrites on the blood-vessels is antagonized by the members of the digitalis group and by salts of barium.

Therapeutics.—Sweet spirit of nitre is employed as a popular remedy [as well as by physicians] at the commencement of a cold; and as a mild diaphoretic and febrifuge [and as a renal stimulant]. Its action is, to a very great extent, due to its power of dilating cutaneous vessels, thus exposing a larger amount of blood to the air. It has also been given with success in angina pectoris. It is commonly employed in asthma, and also in painful menstrual disorders.

It may be given in full doses, and the administration of from two to three drachms is not, as a rule, followed by any untoward symptoms.

ACETANILIDE

Phenylacetamide or Acetanilide, when first introduced into medicine, was known as antifebrin, a term employed to indicate its antipyretic action. It is a crystalline substance, only slightly soluble in water.

Action.—It is a powerful depressant of the nervous system; markedly diminishes the spinal reflexes and, in large doses, produces tremor, followed by convulsive movements, marked fall in temperature, coma, retention of urine, and general paralysis. Not infrequently the patient suffers from cyanosis, great dyspnœa, and, possibly, symptoms of collapse. After toxic doses the pulse is weakened and thready, and respiration becomes first rapid, then impaired and labored. The urine is reddish yellow in color, from its richness in urobilin, and reduces Fehling's solution. The toxic symptoms are probably due to the formation of aniline.

THERAPEUTICS.—Acetanilide [besides its antipyretic properties] is an analgesic, and has been used with some success in the treatment of facial and intercostal neuralgias. [External use has been made of it in powder form as a substitute for iodoform.]

It has not maintained its early reputation, and the occurrence of such symptoms as lividity, cyanosis, profuse sweating; with disturbances of the circulatory, respiratory, and nervous systems, has induced some hesitation in prescribing it. The ordinary dose is from three to ten grains, and it may be given in wine, spirits, tincture of orange, or aromatic spirit of ammonia.

PHENACETIN

Phenacetin, or para-acet-phenetidine, was introduced into medical practice by Prof. Kast and Dr. Hinsberg, in 1887. It is closely allied to antifebrin, and appears in the form of a colorless, odorless, and nearly tasteless microcrystalline powder which is only sparingly soluble in cold water, [and not soluble in acid or alkaline liquids].

It has been used with success in cases of headache and neuralgia, and is especially useful in the fugacious and variable forms which are so common with the hysterical and neurotaxic.

It may be given in five-grain doses [at first to those whose tolerance is unknown, and, if no undesirable symptoms follow, the dose may be doubled if requisite. It may be given either in a wafer or dissolved in simple elixir; but not infrequently the powder is placed on the tongue and followed with water. Owing to tardy solubility the form of compressed tablet is not desirable. If it is to be given as a powder in water, it should first be moistened with a few drops of any alcoholic liquid; otherwise it will float on the water and adhere to the side of the glass or spoon].

There is no doubt that it is a good antipyretic; but its use requires caution. Even in the case of robust individuals a dose of from fifteen to thirty grains will produce a feeling of fatigue, with yawning and somnolence—a condition often followed by vertigo, shivering, weakness of the pulse, and hurried respiration. Its extreme insolubility renders it somewhat unmanageable, and confers on it a marked inferiority to many other members of the aromatic series.

[Much caution should be used when it is given to phthisical cases. Its antipyretic effect appears to be much more persistent than that of antipyrin. Coincident with fall of temperature there is commonly profuse perspiration; but seldom is this very marked unless the degree of fever has reached or exceeded 102° F.]

PHENAZONE [ANTIPYRIN]

This is our old friend antipyrin under another name. It is also known as analgesin [methozone, parodyne, phenylone, sedatine, dimethyl-oxy-quinizine, etc.], but its full and proper name is phenyl dimethyl-pyrazole. It was discovered by Dr. Knorr, and its physiological action was first investigated by Dr. W. Filehne.

It occurs in the form of colorless, odorless scales [or crystalline powder], which have a somewhat bitter taste, and are freely soluble in water or alcohol. This water-solubility gives it decided advantage over similar preparations. It has a basic action, and readily combines with acids to form salts, but it is probably not a true alkaloid.

After small doses, the symptoms not infrequently observed are epigastric pain, nausea and vomiting, followed by weakness of the pulse, hurried respiration, and cyanosis. In some cases there is persistent sneezing, with lachrymation, and a flow of mucus from the nostrils. After larger doses, the symptoms observed are intense headache, persistent vertigo, loss of memory, confusion of ideas, and deafness. In several cases collapse has followed the administration of twenty-grain doses, the condition of the patient being for some time critical. Even when serious symptoms are not observed, the patient frequently suffers from persistent itching of the inner sides of the thighs, with a painful, urticarial, [or scarlatiniform rash, especially, it is said, when given with arsenic], which gradually extends upward over the abdomen.

It is probable that phenazone exerts a decided influence on metabolism. The temperature, pulse-frequency, and blood-pressure are all reduced, and the amount of urea excreted is lessened. After large doses, methæmoglobin is formed in the blood—a circumstance which accounts for the frequency with which cyanosis is observed. The fall of temperature, which follows its administration in cases of fever, is not due to the production of sweating, as it is observed when atropine has been previously administered to prevent its action on the skin. There is clearly diminished heat-production, which is, in all probability, due to the fact that antipyrin is a general protoplasmic poison. The drug is eliminated by the urine.

THERAPEUTICS.—Antipyrin was originally introduced as an antipyretic, but after a time was employed almost exclusively as an analgesic. It has been recommended for all sorts of complaints, and for the relief of all kinds of symptoms; is prescribed in all forms of megrim and neuralgia, dysmenorrhœa and menorrhagia, in gout, asthma [etc., excepting malarial fevers]. In the late influenzaepidemic [in England] it was freely recommended as a specific in all the daily papers, without a single word of warning as to its toxic action. At the present time it is probably much more largely employed by the public than prescribed by medical men, and has, unfortunately, passed into the category of popular remedies.

[As a hæmostatic and for other external uses, it is employed as a dusting-powder and in a 20 per cent. solution.]

ANTISEPTICS

Antiseptics are substances which prevent or retard putrefaction, by destroying or preventing the development of bacilli which give rise to septic decomposition. They are employed chiefly in surgical practice, in the treatment of open wounds. The best are those which, while acting efficiently on the ferment, exert no injurious effect on the tissues themselves.

Amongst the chief antiseptics are: Carbolic acid and the sulpho-carbolates, creasote, salicylic acid, salicylate of sodium and salicin, resorcin, menthol, thymol, eucalyptol, borax and boric acid.

Corrosive sublimate is probably the most powerful of all antiseptics, but is very poisonous. Most essential oils, *e. g.*, those of cloves, thyme, cajuput, and peppermint, possess antiseptic properties.

CARBOLIC ACID AND CREASOTE

Carbolic acid, phenic acid or phenol, is a product of coal-tar distillation. When pure it is in the form of colorless, acicular crystals, which melt at 95° F., forming an oily liquid. It has a strong, peculiar, and characteristic odor and taste. The crystals readily absorb moisture from the atmosphere. It is not very soluble in water; but dissolves readily in alcohol, ether, and glycerin. Although an acid, it only faintly reddens litmus paper, [and, in some respects, might be classed with the alcohols.] It coagulates albumin. It is fatal to all forms of animal life, from the highest to the lowest, and its use in surgery and medicine is mostly due to its action on infusoria and fungi.

In most animals, when given internally, it causes intense muscular weakness, convulsions, and stupor. The convulsions are probably due to a tetanizing influence on the spinal cord; at all events, it produces very little effect on the nerves or muscles. It acts as a cardiac depressant; its influence on the respiratory and vascular nerve-centres being indicated by frequent and dyspnœic breathing, and by a transitory rise of blood-pressure. In man, headache, giddiness, weariness, and discomfort precede the stupor. Death results, both in animals and in man, from collapse due to paralysis of the respiratory and vascular nerve-centres.

Applied to the skin, carbolic acid acts as an anæsthetic. At first it causes slight burning; then the skin becomes numb, white, and shrivelled, so that an incision may be made without causing pain. After prolonged application, or if applied in a concentrated form, the skin sloughs, giving rise to an eschar, which is dry, and subsequently falls off without suppuration.

When swallowed in a concentrated form, it acts as a caustic upon the mucous membrane, causing intense pain, nausea, vomiting, and symptoms of gastro-enteritis.

It is excreted by the kidneys and turns the urine blackish, the discoloration being due to some oxidation product of carbolic acid—probably hydroquinone. It appears in the urine, combined with sulphuric acid, in the form of sulpho-carbolates. The earliest symptom of carbolic acid-poisoning is the disappearance of sulphates from the urine.

In cases of poisoning, the best treatment is administration of Epsom salt, or Glauber's salt, in plenty of water. White of egg and olive oil are useful in protecting the irritated mucous membrane with which the acid has come in contact.

Sulpho-carbolic acid is formed by the direct union of pure carbolic acid with sulphuric acid. **Sulpho-carbolate of sodium** is made by neutralizing this acid with carbonate of sodium, evaporating, and crystallizing. Many sulpho-carbolates have been obtained, and are simply convenient forms for giving carbolic acid. They have decided antiseptic properties, but in this respect are inferior to carbolic acid itself.

Sulpho-carbolate of sodium is decomposed in the blood, sulphate of sodium being eliminated with the urine and carbolic acid with the breath.

The use of sulpho-carbolates has been suggested in phthisis [and in malarial toxæmia], but the suggestion is of no practical value. It is used, however, in the treatment of flatulence, and the following formula is often employed :

Sulpho-carbolate of Sodium,	gr. xx.
Camphor-water,	℥ j.

To be taken every four hours.

Creasote is obtained by destructive-distillation of wood, and, in general properties, is closely allied to carbolic acid. It is prescribed in three-minim doses in the form of a pill [or, mixed with olive oil, in gelatin capsules], and is useful in chronic bronchitis and in gangrene of the lung. The following mixture has been found useful in phthisis :

Creasote,	♏ j.
Tincture of Opium,	♏ ij.
Spirit of Chloroform,	♏ xv.
Glycerin,	ʒ j.
Water,	to ℥ j.

To allay the irritative cough of phthisis, recourse may be had to the following linctus :

Creasote,	♏ ⅛.
Glycerin,	♏ vij.
Water,	to ʒ j.

[Preparations.—Glyceritum Acidi Carbolici, 20 per cent.; Unguentum Acidi Carbolici, 5 per cent.]

SALICYLIC ACID

There are two kinds of salicylic acid—the natural and the artificial. It was originally derived from salicin, oil of wintergreen, and other sources, and this is the variety known as natural salicylic acid. Later on it was prepared by heating carbolic acid with caustic soda, and passing a stream of carbonic acid through it. In 1874 Kolbe introduced an improved method of making it on a large scale and at moderate cost, by evaporating a concentrated solution of caustic soda with phenol to a dry powder; this is then heated to 212° F., and a stream of dry carbonic acid is passed over it. This product is known as artificial salicylic acid.

The natural and artificial varieties differ materially in their physiological actions, the latter being much more toxic than the former.[1]

From experiments made by Professor Charteris on rabbits it appears that natural salicylic acid exerts no deleterious effect in ten-grain doses; but that artificial salicylic acid, in this dose, produces paralysis of the flexors and death. This difference in action depends on the presence, in the artificial variety, of a substance derived from the carbolic acid from which it is prepared. The nature of this body has not been accurately determined; but it is probably a derivative of cresotic acid, or an isomeric variation of salicylic acid. Dr. Charteris (who has devoted much attention to the subject) finds that it is the impurity which is responsible for toxic symptoms so often observed from the administration of the artificial acid. It is found that this substance is more soluble in water than calcium sulphate, and on this fact is based a method of separation, which consists in saturating a boiling solution of salicylic acid with calcium carbonate, and allowing the salicylate of calcium to crystallize out. This method has been improved by Dr. Charteris, and, thanks to his investigations, pure artificial salicylic acid and salicylate of sodium are now prepared, entirely free from toxic properties. Dr. Charteris tested his purified specimens on rabbits, and found that fifteen grains, given hypodermically, produced no bad effect of any kind.

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[1] [There is also a material difference in their cost; the natural acid being quoted as selling for about $7.00, and the "C. P." artificial, for about $0.75 per pound.]

In using salicylic acid clinically, the greatest care should be taken to see that the purified substance is dispensed. The natural acid should be in large crystals resembling strychnine, but slightly yellowish in color. The crystals of the purified artificial acid are similar in shape, but are smaller and whiter.

ACTION.—In man, salicylic acid, given in large doses, induces symptoms not unlike those of quininism—such as a sensation of fulness in the head with a roaring or buzzing noise in the ears. After still larger doses, the chief symptoms are headache, double vision, partial blindness, deafness, and profuse sweating. In full, toxic doses, the patient suffers from ptosis, strabismus, irregular respiration, extreme restlessness which may pass into delirium, a slow and labored pulse, and other indications of grave constitutional disturbance. The fæces are passed involuntarily, and the urine is almost black. The temperature falls to such an extent that it approaches the temperature of collapse. The skin is covered with a rash which is usually of the urticarial type. There is a good deal of difference of opinion respecting the symptoms observed after the administration of large doses of salicylic acid, a discrepancy which suggests that the specimens supplied were subject to considerable variation as regards purity. The symptoms here enumerated are rarely observed with the natural acid, and it is not known that they follow the administration of the purified artificial acid, although undoubtedly they do follow the administration of specimens of the drug which, until recently, were described as purified salicylic acid.

Salicylic acid is eliminated chiefly by the kidneys, the urine assuming a dark-green color, due, probably, to an increased formation of indican. The urine of patients taking large doses of salicylic acid often contains albumin.

THERAPEUTICS.—This substance is of much value as an antiseptic, but is inferior in this respect to carbolic acid. It is not only an antipyretic ; but, as an antiperiodic, is frequently prescribed in the treatment of acute rheumatism, although salicylate of sodium is more commonly employed. This, however, is simply a matter of convenience, and there is practically no difference in the action of the two drugs. Salicylic acid soon reduces the temperature and relieves the joint-pain ; but it will not prevent the occurrence of endocarditis or pericarditis, and is not to be relied on in the treatment of hyperpyrexia.

Quite apart from its employment in acute rheumatism, salicylic acid has many uses. Dusted inside the socks and boots, it prevents decomposition of sweat, and is usually employed in the following form :

Salicylic Acid,		℥ i.
Powdered Starch,		
Powdered Talc,	āā	℥ ss.

In chronic eczema, ointment made as follows is useful:

Salicylic Acid,		
Precipitated Sulphur,		
Resorcin,	āā	ʒ ss.
Lanolin Ointment,[1]	to	℥ j.

Salicylic acid has long had popular reputation as a remedy for warts and corns, and the following application, painted on the affected parts once or twice daily, is efficacious :

Salicylic Acid,		
Alcohol,	āā	ʒ ij.
Sulphuric Ether,		ʒ v.
Collodion,		ʒ x.

OTHER USES.—Salicylic acid arrests putrefaction of all kinds, and prevents the development of bacteria in organic mixtures. A one-per cent. solution arrests the action of ptyalin on starch, and one part of the acid in two thousand of urine prevents decomposition.

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[1] [Consisting of 65 per cent. of lanolin with paraffins and water.]

From its antizymotic properties and its slight taste, salicylic acid is largely used for preserving beer, wine, milk, lime juice, lemon juice, gum, and other fluids liable to undergo fermentation. The French and Germans have forbidden its use for preserving articles of food, but on what grounds is not known. Its use is permitted in this country [Great Britain]; but manufacturers, in their own interest and with a view to possible legislation, would do well to employ only the purified acid, and not the common, commercial variety, which is often impure.

[PREPARATIONS.—Lithii Salicylas; Methyl Salicylas; Physostigminæ Salicylas; Sodii Salicylas.]

Salicylate of Sodium.—This salt is prepared by the action of salicylic acid on carbonate of sodium. Five grains of the salt are equivalent to four of the acid.

The remarks which have been made respecting the purity of salicylic acid are equally applicable to the sodium salt.

ACTION.—Physiologically, it has much the same action as salicylic acid. It often produces a rash, which usually assumes the form of an erythema or urticaria. The buzzing noise in the ears, caused by large doses, may be controlled by the addition of fifteen grains of bromide of sodium to each dose.

It increases the secretion of bile and renders it more watery. Rutherford describes it as being a very powerful hepatic stimulant in dogs. He says: "The certainty of the action of this substance on the liver led us to use it in many experiments as a sort of test of the excitability of the liver." It appears in the urine as salicyluric acid.

In some cases large doses of salicylate of sodium have resulted in hæmorrhages of various kinds—such as epistaxis, hæmaturia, and hæmorrhage into the retina. It is probable that these symptoms result from the use of an impure salt, as they have not been noted when the purified salt has been employed.

THERAPEUTICALLY, it is largely employed in the treatment of acute rheumatism. Thirty grains of purified salicylate of sodium should be given as soon as the patient comes under observation, and twenty grains every four hours afterward. In twenty-four hours the fever will have disappeared, and the joint-pain will have been reduced to the minimum. As soon as the temperature becomes normal the dose of the salicylate may be materially reduced, its place being taken by bicarbonate of potassium or some other alkali. Salicylate of sodium does not, as a rule, succeed well in cases of hyperpyrexia.

In chronic rheumatism, its effect is less marked than in the acute form, although, not infrequently, it temporarily affords relief. Even in cases of gout it may do good. Haig maintains that much of the value, both of salicylic acid and of the salicylates, is due to its power of facilitating the excretion of uric acid, by forming with it a compound which is soluble in slightly acid fluids.

There can be no doubt as to the value of salicylate of sodium in the treatment of acute tonsillitis, and, if given in full doses, it nearly always prevents suppuration. It may also be used as a gargle.

In sciatica, it ranks above the average of remedies used in the treatment of this obstinate disease.

In megrim, a dose of phenacetin may be given to break up the attack, and, in the intervals, fifteen grains of salicylate of sodium should be given, in a cup of black-coffee, twice a day.

The somewhat unpleasant sweetish taste of salicylate of sodium may be disguised by syrup of orange-flower, syrup of ginger, or fluid-extract of liquorice.

To prevent any possibility of misconception, it may be well to state that, by a "large" dose of salicylate of sodium or of salicylic acid, is meant a dose exceeding fifteen or twenty grains every four hours. I do not for one moment believe that salicylic acid, when used for preservation of foods or beverages, in the proportion of, say, 0.038 per cent., is capable of exerting any prejudicial effect on the animal economy, even if taken freely for many weeks in succession. To say that because salicylic acid is used as a local application for corns, it must, of necessity, be harmful even in the smallest possible dose, is, to my mind, an utter absurdity.

PHARMACOLOGY

OF

DRUGS OF VEGETABLE ORIGIN

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ACONITE

By Aconite, we mean the root, fresh leaves, and flowering tops of *Aconitum Napellus*,[1] the common monkshood, wolf's-bane, or blue-rocket. It grows wild in many parts of Europe, and in England is cultivated for ornamental purposes. The root somewhat resembles that of the horseradish, and has been eaten with fatal consequences.[2]

Aconite is the *ἀκόνιτον* of the Greeks, and the *aconitum* of the Romans. It was well-known to the ancients, who regarded it as the most virulent of all poisons, and attributed its origin to Hecate, who, they declared, caused it to spring from the many-headed dog, Cerberus. It is supposed to have been the chief ingredient in the poison-cup mixed by Medea for Theseus. It was used in the island of Ceos to carry out the law which condemned to death all who were no longer useful to the State or able to defend themselves. It was long employed as an arrow-poison, both by the Chinese and the less civilized of the hill-tribes of India. The celebrated Baron Störck, of Vienna, introduced aconite into medical practice in 1762, and Fleming's essay on its physiological action and therapeutic uses (for which the Senatus Academicus of Edinburgh awarded the gold medal in 1844) did much to bring it into note. Schmiedeberg says: "The rather numerous empirical indications for the application of aconite given in past times, have for the present been entirely given up in Germany"; and adds, that it can now be considered without hesitation as an obsolete remedy. This may be true of Germany, but it is not true of England [nor of the United States], where it has been steadily increasing in favor, and is regarded by our best clinical observers as one of the most valuable remedies at their disposal.

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[1] [The root—or, to be precise, the tuber—is the only portion official in the United States.]

[2] [Only one species, *A. Fischeri*, exists to any extent in the United States, and that only in the Rocky Mountains.]

The active principle of aconite is usually said to be aconitine or aconitina, formerly known as aconitia. It is an alkaloid obtained not only from *A. Napellus*, but from other species of aconite. It is met with in white, generally amorphous, irregular lumps, but may be obtained in acicular crystals. It is soluble in four thousand parts of water, and in ether, dilute acids, and alcohol. Like other alkaloids, it forms salts with acids. Another principle is described under the name of napelline, and there is an acid called aconitic acid.

Considerable doubt still exists as to the meaning which should be attached to the word aconitine.[1] Commercial aconitine is not a simple substance, but a mixture of several alkaloids. Binz, of Bonn, at the International Medical Congress, held in London, in 1881, stated that there was no definite chemical compound sold under the name of aconitine; the various preparations obtainable in England, France, Switzerland, and Germany differing so much in character and composition, that any results obtained by experimenting with them were applicable, only, to the particular sample employed, and not to aconitine in general. Flückiger and Hanbury, in their "Pharmacographia," state that commercial aconitine is a mixture of aconitine, pseudaconitine, picraconitine, and other substances. Wright apparently recognizes three alkaloids obtained from different species of aconite—aconitine from *A. Napellus*, pseudaconitine from *A. ferox*, and japaconitine from one or more Japanese species. It is doubtful whether our aconitine is obtained from *A. Napellus*, from *A. paniculatum* (which both Fleming and Christison found to be inert), from *A. ferox* (the Bish poison), or from the Japanese species. The statement contained in the British Pharmacopœia, respecting the origin of the alkaloid, must be accepted for what it is worth; but in reality we do not know whether our aconitine is aconitine proper, or pseudaconitine, or japaconitine, or a mixture of all three. Cleaver and Williams stated, at the Pharmaceutical Society, that extract of aconite was frequently made from *A. paniculatum*. Mr. Holmes found that a large proportion of the aconite root sold as *A. Napellus* was, in reality, Japanese aconite; and he stated that *A. ferox* was often employed in this country [England] in the preparation of the alkaloid.

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[1] MURRELL: British Medical Journal, 1882, vol. i., p. 555.

It is generally considered that the English aconitine is at least seventeen times as active as the German, the French being intermediate in power; but this classification into English, French, and German is clearly unreliable and unscientific. Professor Pflugge, of Gröningen, investigated the physiological action of seven different kinds of aconitine, and considered that they might be arranged in the following order of increasing activity: 1. Friedländer (Trommsdorf, of Erfurt); 2. Schuchart; 3. Merck, of Darmstadt; 4. Hopkin and Williams; 5. Hottot, of Paris; 6. Morson; 7. Petit.

This list is obviously incomplete, no mention being made of Duquesnel's crystallized aconitine, which is said to be more active than any of the amorphous varieties. Pflugge found that Merck's aconitine was from twenty to thirty times as active as that of Friedländer, while Petit's was eight times as active as Merck's. It must be remembered that this is not a mere matter of curiosity, but is of considerable practical importance, several cases of poisoning having occurred from the substitution of one kind of aconitine for another. Desnos records a case, the subject of aortic disease, who suffered from severe anginal attacks. With the view of affording him relief, his medical advisers prescribed Hottot's granules of aconitine. The chemist, to whom the prescription was taken, substituted for the special aconitine which had been ordered, an aconitine which he happened to have in stock, the source of which was not known, but which was probably of German origin. Gradually, by the advice of the physicians, the dose was increased to four granules a day. The quantity was taken for several days with marked relief to the anginal attacks, and without producing any bad symptoms. At last the chemist, having exhausted his original stock, went to Hottot's for a further supply. On the following day the patient, after taking the usual number of granules, which (unknown to him) had been prepared with the new aconitine, suddenly presented alarming symptoms of poisoning: pains in the head, vertigo, loss of voice, great muscular weakness, pallor, anxiety, weakness of the pulse, failure of the heart's action, a tendency to fainting, coldness of the extremities, and profuse perspiration. The respiration was feeble, irregular, short, and sighing. The patient was, in fact, in a most critical condition, and it was many hours before he was out of danger. In another case, investigated by Pflugge and Huisinga, the patient was killed outright by the substitution of Petit's nitrate of aconitine for Friedländer's, which the physician had intended to prescribe, but had neglected specifically to indicate. In Germany, Busscher has recorded three cases of poisoning by French aconitine. In one case, which terminated fatally, the dose was prescribed by a physician who was under the impression that the French and German aconitines were identical.

General Effects.—Given internally, aconite induces a warm and pungent sensation in the parts with which it comes in contact. Tingling of the lips and tongue is soon perceived, the tongue and uvula feel as if swollen, and deglutition is performed frequently. A large dose induces tingling and numbness of the whole body, accompanied by diminished sensibility and muscular weakness. The most sensitive parts are affected first, the tongue and lips, tips of the fingers, perineum, breasts, abdomen, and lastly the back. There is great dyspnœa, and breathing is shallow and labored. The dyspnœa depends, to a considerable extent, upon feebleness of the circulation and consequent imperfect nutrition of the nerve-centres. The skin is cold and covered with profuse sweat. The countenance is anxious and sunken, and the eyes are protruded. These symptoms are due to the effects of imperfect respiration. The pupils are dilated, but when there are convulsions they may be contracted. The temperature falls 2° F. or more, and there may be rigors or convulsions. Death often occurs suddenly, especially after some movement or exertion, such as sitting up in bed. Delirium may be observed, but usually the mind is clear to the last. Muscular weakness is always a prominent symptom, and blindness, deafness, and loss of speech are not uncommon as the case approaches a fatal termination.

The tingling of the tongue produced by aconitine was an important piece of evidence in the celebrated Lamson case. Dr. Stevenson and Dr. Dupré both stated that, when a very minute quantity of an extract of the contents of the stomach containing this alkaloid was placed on the tongue, it produced a burning sensation which extended to the lip, although the extract did not touch the lip. The character of the sensation was a burning, tingling kind of numbness. It produced an increased secretion of saliva, a desire to expectorate, and a sensation at the back of the throat as if it were swelling up. This was followed by a peculiar, seared feeling as if a hot iron had been drawn over the tongue or a strong caustic applied to it. The sensation on the tongue lasted for four hours. Dr. Stevenson, in cross-examination, said that the effect on the tongue was characteristic of aconitine and of nothing else. Veratrine produced quite a different effect on the tongue, delphinine was more like atropine, whilst piperin had an immediate, burning effect. Cocaine was not generally known at that time, and no questions were asked about its action.

Aconitine is eliminated with the urine and fæces.

Nervous System.—Aconite, being a protoplasmic poison, destroys the functions of all nitrogenous tissues; first of the central nervous system, next of the nerves, and finally of the muscles. It has, moreover, a special affinity for the sensory nerves. On painting a frog's legs with strong solution of aconitine, the nerves are paralyzed, so that on pinching the leg no movement is excited, although the animal can hop about as actively as ever.

Heart.—Moderate doses of aconite reduce the number of the heart's pulsations, which may fall even to forty in the minute. Large doses often temporarily increase the frequency of the heart's beat; but in either case the pulse becomes weak and irregular. The topical application of a solution of aconitine to a frog's heart arrests it in diastole. The large, distended, black heart of aconite is characteristic, and presents a marked contrast to the small, pale, firmly-contracted heart of digitalis.

Aconitine produces this effect on the extirpated heart of a frog and, also, when the pneumogastrics are paralyzed by atropine or are cut, showing that it acts either on the muscular substance of the heart itself or on its motor ganglia. It is thought that in mammals it acts, in addition, upon the vagus roots in the medulla.

Experiments have shown that aconite affects all the structures of the heart in the order of their development: first its ganglia, then its nerves, and lastly its muscular substance. After death the heart fails to respond to electrical stimulation. Aconite lowers arterial pressure, and, as it does not affect the vaso-motor centres or nerves, this is evidently due to the diminished action of the heart.

Respiration.—Moderate doses slow the breathing, but large and poisonous doses make it short and hurried. This action is probably due to the direct action of the drug on the respiratory-centre, aided by its indirect action in weakening the circulation.

Muscles.—As aconite is a general protoplasmic poison, the muscles suffer in conjunction with other tissues.

Skin.—In frogs poisoned with aconite a peculiar frothy condition of the skin is noticed. Sometimes the froth is so abundant that it completely covers the animal. This condition is not produced by any other drug—not even by pilocarpine. It is quite distinct from the desquamation due to arsenic.

THERAPEUTICS.—Aconite is an invaluable remedy in the initial stage of all acute febrile diseases. A characteristic example of its power is afforded by the beneficial effect it exerts in the early stages of acute tonsillitis. It must be given in small doses, frequently repeated. Half a drachm of the tincture [of the Br. Pharm., or *ten minims* of the U. S. Pharm. tincture--the latter being about three times the strength of the Br.] is added to four ounces of water, and of this a teaspoonful is given every ten minutes for the first hour, and subsequently hourly, for four or five hours. The temperature falls, the pulse is reduced in frequency, the skin becomes moist, the throat is less painful and, not uncommonly, the patient falls into a comfortable sleep, from which he awakes not only refreshed, but in every way better. In the initial stages of the acute febrile diseases, such as scarlet-fever and measles, it helps to bring out the rash, and apparently mitigates the severity of subsequent symptoms.

Aconitine is very largely used, especially on the Continent, for internal administration in cases of obstinate neuralgia.

The dose of the tincture, as given in the [British] Pharmacopœia, is from five to fifteen minims, but this is too much. In practice, half a drachm is added to four ounces of water, and of this mixture a teaspoonful is given every quarter of an hour for an hour, and subsequently hourly, for six hours, or until the acute symptoms are relieved. It can also be obtained in the form of tablets, each containing one minim of the tincture, but these are not official. The old Fleming's tincture is about six times as strong as the tincture of the [British] Pharmacopœia. Drop for drop it is as poisonous as prussic acid.

The ointment [official in Great Britain, but not in the United States] is a preparation, not of aconite, but of its alkaloid, aconitine. It is called unguentum aconitinæ, and not unguentum aconiti. It rapidly produces tingling and numbness of the parts into which it is rubbed. The patient should be told to use a piece not larger than a small bean. Care must be taken not to rub it into the eyes or mouth, and to avoid abraded surfaces, or enough may be absorbed to produce constitutional symptoms. It is an expensive preparation, and should not be prescribed *ad libitum.*

Most liniments used as "pain-killers" contain aconite. Some time ago I published the result of an analysis of St. Jacob's Oil. It contained turpentine, ether, alcohol, carbolic acid, capsicum, aconite, and a small quantity of origanum, the latter being probably employed for scenting purposes. The percentage of its composition will be found in the British Medical Journal of May 5th, 1894; but, without going into all the figures, it may be said that turpentine, with traces of camphor, constituted nearly 82.5 per cent.

A good formula for a neuralgia-liniment is the following:

Aconitine (B.P.),	gr. j.
Essential Oil of Mustard,	ʒ j.
Glycerin,	℥ j.
Alcohol,	to ℥ vj.

It is for external application only, and care should be taken to label it "poison."

[PREPARATIONS.—Extractum Aconiti Fluidum; Tinctura Aconiti, 35 per cent.]

OPIUM

Opium: "The gift of God to suffering humanity, the dread agent of unimaginable pleasure and pain." This is the poetical description; a more prosaic definition is: The dried or inspissated juice of the unripe capsule of *Papaver somniferum*, hardened in the air.[1]

The word opium presents some points of interest. In a primitive sense it signified any juice (ὀπός—*opos*=succus). There was formerly a class of remedies known as "opiata," which did not of necessity possess narcotic properties, and into the composition of which the juice of the poppy in no way entered. The word opopanax is derived from ὀπός and πανάξ (*panax*), the latter being the name of the plant which yields it.[2]

Impurities and Adulterants.—The substances used to adulterate opium are pounded poppy-capsules, apricot pulp, figs, stones, sand, clay, bullets, treacle, sugar, and cows' dung. Bullets and cows' dung are at a premium in opium-producing countries.

Active Principles.—Opium contains active principles, of which there are seventeen alkaloids, all told, neutral bodies, and acids. Of the alkaloids, the most important and the most commonly employed is morphine. Other alkaloids of opium are: codeine, thebaine or paramorphine, codamine, cryptopine, narcotine or anarcotine, laudanine, and papaverine.

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[1] [" The concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné * * * and yielding, in its normal, moist condition, not less than *nine* (9) per cent. of crystallized morphine, when assayed by the process given * * * ."—U. S. Pharm.]

[2] It is not uncommon to find a word, which was originally used to express general characters, subsequently applied to some specific substance possessing these characteristics in a pre-eminent degree. The word Ἀρσενικον=*arsenikon*, from which "arsenic" is derived, was applied originally to all substances of a very active and poisonous nature. In a similar manner "verbena," or "herbena," was applied to all herbs held sacred in the rites of the sacrifice; although now it is used to indicate the plant in particular. "Vitriol," in its original application, denoted any crystalline body having a certain degree of transparency. The term "bark" is used for the particular bark of all others most largely employed in medicinal practice. "Elaterium" was used by Hippocrates to signify any medicines given internally, especially those possessing purgative properties, and was not, as now, confined to the juice of the squirting cucumber.

Some of these are of no practical importance and are hardly worth remembering.

The neutral bodies contained in opium are: narceia and meconin.

The acids contained in opium are: meconic acid and thebolactic acid.

Meconic acid is used in the preparation of bimeconate of morphine. It is met with in the form of micaceous crystals, nearly colorless, sparingly soluble in water and freely soluble in alcohol. It is used in making the liquor morphinæ bimeconatis [Br. Pharm.], a preparation which, judging from the accounts of the Therapeutic Committee of the British Medical Association, is very rarely employed.

Thebolactic acid is probably identical with lactic acid.

In addition to these substances opium contains several resins, a variety of gummy, extractive, and fatty matters, and various inorganic salts.[1]

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[1] [According to the views of its constituents at present adopted, it contains: 1, *Morphine*; 2, *Narcotine*; 3, *Codeine*; 4, *Thebaine*; 5, *Papaverine*; 6, *Narceine*; 7, *Oxynarcotine*; 8, *Hydrocotarnine*; 9, *Pseudomorphine*; 10, *Protopine*; 11, *Laudanine*; 12, *Codamine*; 13, *Rhœadine*; 14, *Meconidine*; 15, *Cryptopine*; 16, *Laudanosine*; 17, *Lanthropine*; 18, *Gnoscopine*. Besides these, Hesse has announced another, *Deuteropine*, but has not yet isolated it. Still others, like *Apomorphine*, can be produced from those existing in the opium. *Opianine*, described by Hinterberger in 1851, was found by Hesse as being merely impure narcotine. Two acids at least occur combined with these bases in opium: *meconic acid* and *lactic acid*. This latter, supposed by T. and H. Smith to be a peculiar variety of lactic acid, and named by them *thebolactic acid*, was ascertained by Stenhouse to be the ordinary variety. * * * Opium also contains *mucilage*, *pectic matter*, and a *glucose sugar*. The wax gathered from the refuse of opium yielded Hesse *palmitate* and *cerotate* of *cerotyl*. Two neutral principles have, moreover, been extracted from opium—*meconin* (*opianyl*) and *meconiosin*."—U. S. Dispensatory, 1888.]

Morphine or morphia was discovered by Sertürner in 1804, and to its presence the chief effects of opium are due. Its formula is $C_{17}H_{19}NO_3$. It may be either amorphous or crystalline. It is soluble in alcohol and slightly soluble in ether and in water. Good opium contains from six to twelve per cent. of it[1] combined with meconic acid. The following are its most important salts:

The *acetate*, met with as a white powder or in fine needles. It is soluble at ordinary temperatures in 2.5 parts of water, and is also soluble in alcohol. It is from this salt that the hypodermic injection of the Br. Pharm. is prepared.

The *hydrochlorate*, occurring in plumose crystals, is less soluble than the acetate, requiring 24 parts of water.

The *sulphate*, which is in white, acicular crystals, is a stable salt, and dissolves in 23 parts of water. It is the favorite salt in the United States.

Derived from morphine and codeine is the hydrochlorate of apomorphine. This is not an alkaloid *contained in* opium, but is a derivative made by heating morphine, or codeine, for some hours in a sealed tube with hydrochloric acid. The morphine loses one molecule of water, and undergoes an entire change in physiological action.

ACTION.—When taken in small doses, opium produces a condition of excitement, evidenced by the pulse being fuller and quicker, and by the surface of the skin becoming warm and flushed. During the prevalence of this stage the patient has the power of directing his energies in any required direction. For example, if he desires to sleep and the conditions are favorable, a repose of mind and body ensues which is eminently conducive to this end. If, on the other hand, he wishes to work, write, study, compose, or what not, he can do so with increased ease and power; accomplishing feats which, to him, in the normal condition, would be difficult or, perhaps, impossible. His imagination is more vivid, his thoughts flow more rapidly, and his powers of expression are enhanced.

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[1] [Nine per cent. is the lowest allowed by the U. S. Pharm.]

The pulse in this stage is at first slightly quickened, but it soon resumes its normal rate, although it remains stronger and more resistant. The mouth and pharynx become dry, and there is often a slight access of perspiration. The after-effects are headache, constipation, dry tongue, and loss of appetite.

With still larger doses the stage of excitement is brief, and is followed by profound sleep from which the patient can still be aroused. During the stage of sleep the brain is anæmic, both the arteries and the veins being contracted. After very large doses the primary excitement is almost absent. Giddiness and a sensation of oppression ensue, followed by an irresistible craving for sleep. There may be nausea, and even vomiting. This sleep passes into profound insensibility, and the breathing becomes slow and shallow. The pulse, at first full and strong, becomes small, feeble, and thready; the face, pale or livid and bloated, and the veins are swollen. The power of swallowing is gradually lost, the pupils become contracted to a pin's-point and insensitive to light, the muscles relax, and the patient cannot be roused.

Opium diminishes the action of all the secretory and excretory organs, with the exception, perhaps, of the skin. It arrests digestion, and causes constipation. Given in small doses, in combination with ipecacuanha, it acts as a mild diaphoretic.

In exceptional cases both opium and morphine produce a rash accompanied by intense itching. The "pruritus opii" has been frequently noticed, and is described as an annoying and unbearable affection. The rash presents a scarlatinoid appearance, and even the mouth and throat may be attacked by erythematous inflammation.

In frogs, the functions of nerve-centres are abolished in the order of their development. Frogs have no higher centres to speak of, and these consequently escape. Their spinal cord, however, is active, and the tetanizing alkaloids, such as thebaine, make their influence felt—the animal being thrown into powerful convulsions.

Birds are peculiarly insensitive to the action of opium; but morphine induces a fall of temperature, often amounting to five degrees or more.

It is usually stated that morphine acts on dogs very much as upon man, eight or ten grains inducing profound sleep, amounting almost to coma; but recent observations show that dogs are but slightly susceptible to the action of this alkaloid. H. C. Wood and David Cerna gave a dog, weighing 15½ kilogrammes, a dose of 2.4 grammes (37 grains) of morphine, without affecting its respiration. Caldwell gave a dog 17 grains, without producing serious symptoms; and to a number of other dogs he gave 12 grains hypodermically, with no bad effect. Dogs usually vomit when morphine is given by mouth.

It is said that doses of morphine which, given hypodermically to rabbits, produce profound narcosis, have no effect if administered by mouth. In one instance a rabbit took five grains of morphine, without any apparent effect; but a grain of the alkaloid, administered hypodermically, produced narcosis.

A horse will take as much as thirty-six grains of morphine, and recover after a prolonged sleep.

There is a difference, undoubtedly, between the action of morphine on man and on the lower animals, owing to the immensely higher cerebral organization of the former, which renders him infinitely more susceptible to the cerebral action of the drug.

Morphine is eliminated chiefly by the bowels; to a smaller extent by the kidneys, and still more slightly with the saliva. The man who would use a stomach-pump in a case of poisoning by hypodermic injection of morphine would, by most people, be set down as an ignoramus; but he would be right, for it has been shown experimentally that, when the drug is administered subcutaneously, much of it is eliminated by the stomach—in fact, by repeatedly washing out the stomach, more than half the quantity injected may be recovered.

There are many circumstances which modify the action of opium and morphine:

Age is undoubtedly an important factor, children being much more easily affected by preparations of opium than are adults. In this respect it presents a marked contrast to belladonna and other members of the same group, which are readily taken by young people without the production of physiological symptoms. Opium has to be given with great care to infants, even a few drops of laudanum, added to a linseed-meal poultice and applied to the chest, sufficing to induce symptoms of poisoning.

Tolerance, or custom, are other important factors.[1] In Turkey and other Eastern countries, where the use of wine is prohibited by the established religion, opium is consumed in immense quantities, either mixed with rich syrups and the juice of fruits to make it more palatable, or in small lozenges made up with spices and stamped with the words, "*Masch Allah*"="The gift of God." People who are in the habit of taking opium are not affected by even very large doses. De Quincey, for example, took as much as three hundred and twenty grains a day, and could drink laudanum by the tumberful. The custom of opium-eating is very common in many parts of England, especially in the fen districts. Opium-smoking has of late become a favorite amusement with [British ?] ladies of fashion, and the opium-pipe is in constant requisition ; the preparation employed being the solid extract.

Race is not without influence. Malaccans, for example, bear it badly, and are excited by it to a condition bordering on mania.

Elimination has undoubtedly much to do with the effects produced. When the kidneys are diseased, it is not readily eliminated, and symptoms of poisoning may suddenly make their appearance. It has been laid down as a rule that opium should not be given in Bright's disease or in bronchitis, and this, with certain modifications with respect to dose, may be taken as correct.

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[1] [The existence of severe pain produces a degree of temporary tolerance depending, somewhat, upon individual characteristics.]

HABITUAL USE of morphine hypodermically is a serious matter, although I know of one case in which a lady took an injection twice a day, for a period of nearly twenty years, without suffering any particular inconvenience. It never made her drowsy, and the only apparent effect was to improve the appetite. When, however, the patient has become a slave to the syringe, means to break off the habit may be resorted to with advantage. In slight cases, when administration of the morphine is still in the hands of a medical adviser, the following rules may be found useful :

Do not stop the injections suddenly.

Diminish the dose gradually, and without telling the patient.

Do not give it alone, but combine it with atropine.

Diminish the dose of morphine, and increase the dose of atropine until the effects of the latter predominate. When the full effects of atropine are experienced, the patient will complain that the injections have lost their influence, and will ask to have them discontinued.

In more confirmed cases, when administration of the drug is in the patient's hands, the following hints will be serviceable :

The patient must give up the custody of the syringe and of the morphine solution.

The dose must be diminished gradually, so as to make but little demand on the moral strength and self-control of the patient ; the rate of reduction not exceeding a sixteenth of a grain every three or four days.

The bowels should be kept well open.

Tonics should be given—quinine, or nux vomica, with capsicum and hydrochloric acid, for example.

If the patient cannot sleep, give bromide of sodium in half-drachm doses, in plenty of water, every night at bedtime, and this dose may be repeated if necessary.

If the stomach is irritable, or if diarrhœa is a prominent symptom, give subcarbonate of bismuth in half-drachm doses, in milk, three times a day. Another good remedy is carbolic acid and tincture of iodine, equal parts, one drop to be taken in water three times a day, before meals.

If there be much depression, stimulants may be given, but cautiously and only in measured doses. Dry, iced champagne is useful, and so is wine of coca.

Isolation may have to be resorted to; but it is better to keep your patient occupied and amused. Theatre-going (if a properly ventilated theatre can be found) is a valuable therapeutic agent.

Finally, the patient must be fed up; a good cook is half the battle.

Codeine or codeia, discovered in 1832, is the second most important alkaloid of opium. It is contained in the opium and is not derivative. It is the methyl ether of morphine, and can be prepared artificially from the latter. It is in colorless, octahedral crystals, soluble in hot water. From a quarter to one-per cent. can be extracted from good opium. Codeine, like morphine, combines with acids and forms salts, but they are rarely employed. There is a derivative known as apocodeine (said to be prepared by removing one atom of water from codeine), which is analogous in action to apomorphine, and by some authorities is supposed to be identical with it.

Codeine differs chemically from morphine in having the methyl radical (CH_3) replacing an atom of hydrogen—a change which can easily be made artificially. It loses much of the hypnotic power, but, as a compensation, does not act as an astringent nor interfere with the function of the liver.

On man, codeine has a hypnotic action which is far inferior to that of morphine. Some patients will take as much as fifteen grains daily without becoming somnolent. It contracts the pupils. Its most marked action is on the nerves of abdominal viscera. When given for several consecutive days, it lessens the irritability of the digestive tract to such an extent that arsenic produces neither vomiting nor purging. In large doses, it induces intense irritation of the sensory nerve-endings. In a case of poisoning, persistent itching, lasting for two days, was a prominent symptom. It increases irritability of the spinal cord, and, in frogs, produces languor succeeded by convulsions and paralysis.

In rabbits, it produces well-marked but not very deep narcosis. On increasing the dose, the reflexes are found to be greatly exaggerated, and, upon a further increase, tetanus is induced, the animal dying in convulsions.

In dogs, narcosis is readily caused by small doses; but the animals suffer from salivation, vomiting, and diarrhœa.

Codeine was at one time supposed to be preferable to morphine in the treatment of diabetes; but there is no good clinical evidence in support of this. It may be used with advantage in treatment of the cough of phthisis, especially the hacking, irritable cough unattended with much expectoration. The following is suggested as a useful formula:

Codeine,	gr. iv.
Diluted Hydrochloric Acid,	ʒ ss.
Spirit of Chloroform,	ʒ jss.
Syrup of Lemon,	℥ j.
Water,	to ℥ iv.

Make a linctus. A teaspoonful frequently, when cough is troublesome.

The "glycerin and codeine jelly" is by no means a bad preparation.

Thebaine is a tetanizer allied in physiological action to strychnine and brucine. It is a powerful poison, and a tenth of a grain will produce well-marked symptoms in a frog. The convulsions are of spinal origin, as they occur after section of the cervical cord. It exerts no action on the motor or sensory nerves, nor on striated muscular tissue. Its physiological antidote is chloral hydrate.

Anarcotine.—This substance was originally named "narcotine" by its discoverer, Derosne; but as this designation is singularly inappropriate and misleading, it has been [by some] renamed "anarcotine." It is contained in Smyrna opium to the extent of [about] two-per cent. only; this variety of opium being comparatively rich in morphine and poor in anarcotine, while Bengal opium, which is comparatively poor in morphine but is rich in anarcotine, contains [about] six-per cent.

Anarcotine possesses no narcotic properties, but is an antiperiodic, and is used with success in the treatment of malarial and intermittent fevers. In some cases it is but slightly inferior, and in others distinctly superior to quinine. It has long been held in India that opium is a remedy for, and a protective against malarial infection, and the remarkable immunity of opium-eaters from diseases of this type is probably due to the presence of this alkaloid. Sir William Roberts has pointed out that in anarcotine we possess an antiperiodic of great power, analogous to, but not identical with quinine. In India, it was for several years regularly supplied from Government factories at the rate of about a hundredweight per annum, and considerable quantities of the alkaloid are still to be found in many of the medical depots in that country.

It is insoluble in water, but soluble in ether and in dilute acids. Its alkaline properties are weak, and its salts unstable. It may be given in the form of a pill, and, according to Garden, the dose is from one and a half to three grains.

Other Alkaloids of opium call for but little comment, comparatively little being known about their physiological actions.

Cryptopine is remarkable from the fact that it dilates the pupil. *Narceine* is said to be a hypnotic, more active than morphine, and to possess laxative properties. *Papaverine* is said to exert strong narcotic effects without inducing mental excitement.

Many of these statements rest on imperfect evidence.

THERAPEUTICS.—Opium, in various forms and preparations, is used in the treatment of such a multitude of diseases that it is no easy matter to give, within short compass, a detailed account of its therapeutical actions.

Opium, taken habitually by the mouth, acts as an antiperiodic—a circumstance which, to some, explains the large consumption of the drug, both in India and in the fen districts of England.

Laudanum and other preparations of opium are given to check diarrhœa. In obstinate cases an opium enema, consisting of fifteen minims of laudanum with an ounce of decoction of starch, may be injected into the bowel.

Applied on a linseed poultice, it allays the pain of neuralgia, myalgia, pleurodynia, and of superficial and deep-seated inflammations. It is readily absorbed by the skin, producing its constitutional effects. This mode of treatment [as well as the use of opium or its derivatives, in any form] must be employed with caution in the case of children.

[In the United States it is common practice to use the official tincture of denarcotized opium, in preference to the ordinary tincture, for internal administration. Their morphine-strength is alike, but the former is less apt to cause undesirable effects. The camphorated tincture of opium (commonly called paregoric) is a general favorite on account of its carminative properties, and is much used in mixtures for relieving cough, diarrhœa, abdominal pain, etc.]

Ten grains of Dover's powder, made into two pills, will check the profuse night-sweating of phthisis.

Extract of opium, smoked in an opium-pipe, is used for the relief of asthma, the dyspnœa of emphysema, and allied conditions. It is also said to relieve the pain of neuralgia, and to be largely resorted to by women who lead monotonous lives and have few opportunities of indulging in sexual intercourse. In the form of cigarettes, it is smoked to relieve the cough of early stages of phthisis.

Ointment of galls and opium was at one time largely employed as an application to external piles; but of late it has been, to a very great extent, superseded by different preparations of hamamelis.

An opium, or morphine suppository is often inserted into the bowel to quiet intestinal movements after operations. The official [Br. Pharm.] suppository contains half a grain of the hydrochlorate of morphine, and it is quite an open question if this is not too much to employ with safety; at all events, there is a general consensus of opinion that this drug acts much more powerfully when introduced into the bowel than when given by the mouth.

The hypodermic injection of morphine relieves pain and spasm and, in some cases, induces sleep. When tolerance is established, it improves the appetite and, for a time, stimulates the capacity for mental exertion. One of its most legitimate uses is to relieve the dyspnœa of aneurism and of some forms of cardiac disease. It is probably more useful in mitral, than in aortic disease.

For relief of pain, morphine is often given hypodermically in conjunction with atropine, a useful proportion being half a grain of the acetate or sulphate of morphine with a sixtieth of a grain of sulphate of atropine.

There are some points worth mentioning about certain opium preparations :

Compound Powder of Ipecacuanha or Dover's powder, contains both opium and ipecacuanha in the proportion of 1 in 10. It is made up with sulphate of potassium. It is often said that this substance is introduced for its laxative effect, and to counteract the constipative action of the opium. This is nonsense, for there are only eight grains in two five-grain pills—far too small a dose to have any effect. The crystals of sulphate of potassium are hard and angular, and act mechanically in breaking up the other ingredients, thus insuring uniformity in the pill-mass—a point of great practical importance. This powder is called "Dover's powder"—not after the seaport, as has been stated, but in honor of Dr. Dover, who was a friend and pupil of Sydenham. He made a great deal of money as a privateer in the South Seas, and was subsequently elected a Fellow of the Royal College of Physicians.

[*Tincture of Ipecac and Opium*, of the U. S. Pharmacopœia, is intended as a substitute for Dover's powder. *Compound Powder of Morphine* is another substitute which is also official, and is more commonly known as "Tully's powder."]

A compound tincture known as *Compound Tincture of Camphor*, or English paregoric, is called English because there is another preparation known as Scotch paregoric—the *Ammoniated Tincture of Opium.*

Sydenham's Laudanum is met with in many of the foreign Pharmacopœias under the names of laudanum Sydenhami or tinctura opii crocata, and contains saffron.

Battley's Sedative, the liquor opii sedativus, was once a favorite preparation, and is somewhat stronger than the tincture—perhaps fifty-per cent.

Dalby's Carminative contains opium, oil of peppermint, nutmeg, aniseed, and carbonate of magnesium. The proportion of opium is about one-sixth of a grain to the ounce.

Black Drop or acetum opii is four times the strength of laudanum. [In the United States its strength is the same as that of the tincture.]

Nepenthe is a purified, alcoholic solution of meconate of morphine in sherry. [A proprietary article, little known in the United States.]

Godfrey's Cordial is a mixture of sassafras, treacle, laudanum, etc., the strength being half a grain to the ounce.

Chlorodyne is not strictly a preparation of opium, but contains hydrochlorate of morphine, prussic acid, chloroform, ether, alcohol, extract of liquorice, and peppermint;

the usual strength being two and a half grains [of a morphine salt] to the ounce.

Mrs. Winslow's Soothing Syrup is said to contain morphine with essence of anise and syrup of Tolu.[1]

It is usually supposed that the preparations of poppy-capsules contain opium, but on this point there is no definite evidence. The subject is under investigation.

[PREPARATIONS.—Acetum Opii, 10 per cent.; Emplastrum Opii, 6 per cent.; Extractum Opii; Pilulæ Opii, 1 grain; Pulvis Ipecacuanhæ et Opii, 10 per cent.; Tinctura Opii, 10 per cent.; Tinctura Opii Camphorata, 0.4 per cent.; Tinctura Opii Deodorati, 10 per cent.; Tinctura Ipecacuanhæ et Opii, 10 per cent.; Vinum Opii, 10 per cent.

Morphinæ Acetas; Morphinæ Hydrochloras; Morphinæ Sulphas; Pulvis Morphinæ Compositus, $\frac{1}{60}$ gr. in 1 gr. of powder; Trochisci Morphinæ et Ipecacuanhæ, $\frac{1}{40}$ gr.]

APOMORPHINE

The discovery of apomorphine is usually ascribed to Augustus Matthiessen and C. R. A. Wright, although there is reason to suppose that they were, to some extent, forestalled by Arppe. At a meeting of the Royal Society, held June 10th, 1869, Messrs. Matthiessen and Wright read a paper, received on May 6th of the same year, "On the Action of Hydrochloric Acid on Morphine," and in this communication they gave particulars of the mode of preparing a substance for which they proposed the name "apomorphia." It is not necessary to give all the details of their method, but it practically amounted to this: They placed morphine in a sealed tube with a large excess of hydrochloric acid, and kept it at a temperature of from 140° to 150° F. for two or three hours. On breaking open the tube, it was found to contain the hydrochlorate of the new base. This was purified by solution in water; adding an excess of bicarbonate of sodium, and extracting the precipitate with ether or chloroform. On shaking the solution with hydrochloric acid, the sides of the vessel became coated with crystals of the hydrochlorate. These were drained from the mother-liquor; washed with cold water; recrystallized from hot water, and dried on bibulous paper, or over sulphuric acid. This was the way in which they originally obtained their apomorphine; but they found, on further investigation, that the new base might also be prepared by digesting morphine for some days, on a water-bath under paraffin, with excess of hydrochloric acid.

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[1] [Existence of morphine, or of any form of opium, in the preparation has been denied by its manufacturer.)

In this process morphine ($C_{17}H_{19}NO_3$) loses a molecule of water and becomes apomorphine ($H_2O + C_{17}H_{17}NO_2$). They also found that apomorphine might also be obtained from codeine:

$$\underset{\text{Codeine}}{C_{17}H_{17}\,(CH_3)\,HNO_3} + HCl = CH_3Cl + H_2O + \underset{\text{Apomorphine}}{C_{17}H_{17}NO_2}$$

It is probable that in this reaction there is an intermediate product; but with this we are not for the moment concerned.

The same observers showed that apomorphine was formed when morphine was heated with dilute sulphuric acid in a sealed tube, for some hours, at a temperature of 140° to 150° F. This is pretty much what was done by Arppe nearly a quarter of a century previously; his product (which was probably an impure sulphate of apomorphine) being subsequently named by Laurent and Gerhardt "sulphomorphide."

Therapeutics.—Apomorphine is employed quite as frequently in cough mixtures as it is subcutaneously. When emetic effect is required, it is injected under the skin, whereas, for expectorant action, it is given by mouth. If made [as specified by the Br. Pharm.] with camphor-water (which is an undesirable medium), it rapidly turns green on exposure to air, but undergoes no change in physiological action. The direction that it should be prepared as required for use, is unnecessary and misleading, as it retains its properties unimpaired for at least a year. In cases of poisoning, the solution is required at once, and there is no time for sending to a chemist to get it made up.

Apomorphine is a powerful emetic, and is extensively used for that purpose. A dose of a tenth of a grain, given hypodermically, speedily evacuates the stomach and is of much value in cases of poisoning. It is not in any way allied in its action to morphine, and may be used with advantage in cases of narcotic poisoning. Given in this dose, it rarely produces collapse and may be thus employed with perfect safety. In addition to being a powerful emetic, it is a valuable expectorant. In doses of a tenth of a grain, three times a day, by mouth, it facilitates the expectoration of phlegm and does not induce vomiting. Even as much as twenty minims of a two-per cent. solution may be given frequently with perfect safety. It stimulates the respiratory and vomiting-centres, and increases the secretion of bronchial mucus.

Why apomorphine should act as an emetic when given hypodermically, and as an expectorant when administered by mouth, is a subject which has often been discussed. It is, I think, simply a question of the rapidity of absorption. With the view of testing this question I administered, in the form of an ointment, what would be an emetic-dose of apomorphine if given hypodermically. I had three specimens prepared—one with lard, one with vaselin, and one with lanolin—each containing one-tenth of a grain to the drachm. They were given to three different patients with instructions that they should be rubbed into the chest before the fire at bedtime. They produced no emetic effect. The strength of the ointment was then increased in each case to one-fifth of a grain, and the result was the same. I subsequently employed an ointment containing a grain of apomorphine mixed with an ounce of lard or lanolin, directing the patient to rub in half the quantity on two consecutive nights. It acted as an expectorant, the effect lasting for some hours, but induced no nausea. I repeated this in several cases and the results were always the same. I presume that the fact of the drug being comparatively slowly-absorbed affords an explanation of what, at first sight, appears an anomalous result. Practically, it is a decided advantage to have at our disposal a drug which may be relied on to induce an expectorant effect when used in the form of an ointment. In the case of children suffering from bronchitis, this mode of treatment is of much value.

There is no reason why apomorphine should not be given with morphine. Rossbach speaks highly of this combination in the treatment of phthisis, and says that it lessens the frequency of the cough and increases the fluidity of the sputum. Lauder Brunton says: "When apomorphine and morphine are given together they do not destroy each other's action, so that, from the combination, we get increased secretion from the mucous membrane, with diminished irritability of the respiratory-centre and consequently lessened cough. The cases in which the combination is useful are those where there is difficulty in breathing, continual cough, and thick, tenacious mucus."

I have also employed apomorphine as a spray, on the lines of the old ipecacuanha-wine treatment. I used for its administration a bottle with a conical bottom, the silver tube reaching to the apex, so that the whole of the solution could be utilized. I took care to observe the recognized precautions in such cases: using a warm solution; making the patient spit out the fluid which accumulated in the mouth; instructing him not to arch his tongue against the roof of the mouth, and making him inspire deeply with every contraction of the air-ball. I began with ten minims of the one-per cent. solution in a little water, for each inhalation, but I now frequently give as much as half a drachm at a dose. The expectorant effect is very marked, especially with the large doses.

The points to remember about apomorphine are:

That although made from morphine, it has no narcotic properties.

There are two doses of apomorphine—the expectorant, and the emetic dose.

Hypodermically, it is a powerful emetic.

By the mouth, it is the best of all expectorants.

It is not necessary that the solution should be freshly prepared.

A few drops of dilute hydrochloric acid will prevent the solution from turning green.

Mixtures containing apomorphine are conveniently flavored with syrup of wild-cherry.

COCA AND COCAINE

By coca is meant the leaves of *Erythroxylon coca*, a shrub formerly growing wild in many parts of South America, but now extensively cultivated. The leaves, when matured, are carefully picked by hand, so as to avoid breaking them, and dried. The industry must be a very large one, if reliance can be placed on a statement that the annual production is valued at about $10,000,000.

Coca leaves were used by the aborigines long before their conquest by the Spaniards. They regarded them as a divine gift, and spoke of them as "that heavenly plant which satisfies the hungry, strengthens the weak, and makes men forget their misfortunes." At first the leaves were reserved for religious rites and the use of the sovereign, and to this day they are regarded with superstitious dread by the Indians, who put them in the mouths of their dead to secure a favorable reception in the next world. They were employed by the Peruvians as a medium of exchange and, on the introduction of gold and silver coinage, became the chief article of commerce. The Spaniards were at first opposed to their introduction, and the priests promulgated edicts against them, denouncing them as "*elusio del demonio.*" The prohibition was removed when it was found that they were a source of revenue and when mine-owners recognized their value in sustaining and increasing the productive power of their employees. The earliest account of coca was given by Dr. Monardes, of Seville, in 1569, of which an English translation was published in London, in 1596.

The dried leaves are chewed by natives of South America, to sustain strength and appease hunger in the absence of food. The rural postman, before starting on his long journeys, provides himself with a little bag of the leaves and some finely-powdered lime. When he wishes for a chew, he forms a roll of leaves in his mouth with his tongue, moistens a slip of wood, dips it in the lime or in ashes, and smears it over the roll of leaves. This brings out the flavor and excites a flow of saliva. It is said that these post-runners carry letters more than a hundred leagues without partaking of food of any kind. Native travellers apparently derive such sustenance from chewing the leaves that they frequently take no food for four or five days, although travelling on foot during the whole time. They say that when provided with a good supply of leaves they feel neither hunger nor thirst, and can, without inconvenience, remain eight or ten days without sleep. Miners, chewing the leaves every three hours, and taking no food but an occasional handful of rice or maize, are enabled to work for twelve hours at a stretch without inconvenience.

It is stated that coca does not destroy the appetite, the proof being that, when work is over, those who use it not only enjoy a good meal, but often eat ravenously. It is possible that many of these statements are incorrectly reported and are exaggerated. It is generally admitted that the excessive use of coca is injurious, and that the confirmed *coquero*, or chewer, becomes after a time listless, haggard, and gloomy, and that he is not altogether a lively companion.

A good deal of attention was attracted to the subject of coca-eating in 1876, by the statement that an American pedestrian, Weston, employed the leaves for sustaining his strength in long walks, and also by the publication of papers on its physiological action, by the late Sir Robert Christison and, especially, by the late Mr. G. F. Dowdeswell, the latter of whom investigated the matter very thoroughly.

Mr. Dowdeswell's view was that coca was practically inactive. In his paper, published in the Lancet in 1876, he says: "Without asserting that it is positively inert, it is concluded from these experiments that its action is so slight as to preclude the idea of its having any value either therapeutically or popularly; and it is the belief of the writer, from observations upon the effect on the pulse, etc., of tea, milk and-water, and even plain water—hot, tepid, and cold—that such things may, at slightly different temperatures, produce a more decided effect than even large doses of coca, if taken at about the temperature of the body." Whilst not endorsing this expression of opinion, I can speak from personal observation as to the care with which these experiments were conducted.

[Professor Rusby, of New York, was, a few years since, some time in South America for the purpose of botanical and pharmacological study. Being especially interested in whatever related to coca, because of the recently-discovered properties of cocaine, he was quite surprised to find that it was not always the leaves which seemed most desirable for pharmaceutical uses, that were preferred by a coca-chewer. Oftentimes these would be discarded, and leaves be taken which were the least promising as yielders of the alkaloid; and Professor Rusby was led to believe that the constituent which satisfied the wants of a coca-chewer, may not be the cocaine, after all; but something—volatile it may be—which he did not then recognize.]

Active Principles.—Cocaine, the chief active principle of coca, was isolated in 1860. It is methyl-benzoyl-ecgonine, good leaves yielding about a half-per cent. of the alkaloid. It is soluble in water, alcohol, ether, chloroform, and oil of cloves. It forms salts, of which the hydrochlorate is official.

The alkaloid itself requires more than seven hundred parts of water to dissolve it, but its hydrochlorate is much more soluble, dissolving in half its weight of water. On the other hand, cocaine is soluble in fluid paraffins, in oil of cloves, and in most other volatile or fixed oils, while the hydrochlorate is insoluble in fats or oils, and should not be prescribed with them.

Under favorable circumstances cocaine readily yields derivatives. When heated with mineral acids, it is decomposed into benzoic acid, methyl alcohol, and another alkaloid—ecgonine.

When cocaine is simply heated in watery solution, a less complete decomposition takes place, the solution depositing, on evaporation, a crystalline substance called benzoyl-ecgonine.

The leaves also contain hygrine, a volatile principle. Some varieties of coca contain another alkaloid, known as cinnamyl-cocaine, and a constituent called cocamine is also described.

Action.—A general idea of the properties of coca will have been gathered from the introductory remarks on its history and uses. There is a general consensus of opinion that moderate doses of coca are not hurtful, but are in many cases beneficial. It is said that the drug exerts first a sedative, and then a stimulating effect on the higher nerve-centres. There may be obtained from coca the pleasurable effects both of caffeine and morphine, the chewer experiencing the soothing effect of the former, and avoiding the disagreeable after-consequences of the latter. The complete absence of depression or mental confusion is due to the rapidity with which the period of stimulation succeeds the primary stage. It is probable that coca has the power of diminishing metabolism.

The literature of the physiological action of cocaine has attained such gigantic proportions that it is no easy matter to cope with it. Niemann, as long ago as 1860, noted the fact that cocaine, when applied to the tongue, produced anæsthesia. Schroff, in 1862, found that doses of 0.05 gramme, administered to rabbits, gave rise to disturbance of pulse and respiration, and also produced temporary mydriasis. Froumüller, a year later, showed that doses of 0.03 to 0.33 gramme caused, in man, little or no disturbance. In 1874, Bennett published an experimental inquiry into the physiological actions of theine, caffeine, guaranine, cocaine, and theobromine, and demonstrated that cocaine exerts its influence chiefly on the sensory nerves, and that it is an anæsthetic. In 1876, Ott showed that it dilates the pupil.

These observations, however, appear to have been forgotten; and although various preparations of coca were largely employed as therapeutic agents, the active principle itself was rarely used, and its very existence was unknown to the majority of medical practitioners. Suddenly the whole aspect of affairs was changed. On September 15th, 1884—a date long to be remembered in the annals of therapeutics—Dr. Karl Köller, of Vienna, demonstrated to the Ophthalmological Congress, at Heidelberg, the action of a solution of cocaine when applied to the eye. Dr. Köller, it appears, had long been aware that cocaine acts as a local anæsthetic to the larynx, and it occurred to him that similar results might be obtained if used for other mucous membranes. At the Heidelberg Eye Clinic two drops of a solution were dropped into the eye of a patient, experimentally, and in a few minutes it was noticed that the sensitiveness of the surface was below normal. A drop or two more, and anæsthesia was complete; a probe was pressed upon the cornea until the surface was indented, and was rubbed over the surface of the cornea and over the conjunctiva; a speculum was introduced and separated the lids, and they were stretched to their utmost; the conjunctiva was seized with a forceps, and the globe was moved about in various directions; but there was no pain, and the patient declared that he experienced no inconvenience of any kind. Before the experiment the eye had been tested, and was shown to possess the normal sensitiveness; the other eye, which was not treated, remained, in this respect, perfectly normal. At first a two-per cent. solution was used, but subsequently it was increased to four-per cent.

Knowledge of this wonderful discovery spread quickly, and in a few days there were hundreds of workers in the field which had been so suddenly opened to them. Cocaine was dropped into the eye and rubbed into the skin; applied to the larynx and pharynx, and even injected into the rectum and vagina. The price of the drug rose rapidly, and physicians were found only too pleased to pay half a crown a grain for the privilege of trying it. Every one seemed anxious to do something to associate his name, in however small degree, with so momentous a discovery. The result was the publication of a host of papers and articles, many of them displaying, only too obviously, the signs of haste and crude experimentation.

We have now to consider the present state of our knowledge with regard to the effects of cocaine on special organs and special tissues:

On the Eye.—One of the most striking effects of cocaine is the production of anæsthesia of the conjunctiva when applied topically. Dr. Köller, in his paper, says: "A few drops of a watery-solution of muriate of cocaine, dropped on the cornea of a guinea-pig, rabbit, or dog, or instilled into the conjunctival sac in the ordinary way, cause, for a short time, winking of the eyelids, evidently in consequence of a slight irritation. After from one-half to one minute the animal again opens its eyes, which gradually assume a staring look. If now the cornea is touched with a pin-head (in which experiment we have carefully to avoid touching the eyelashes), the lids are not closed by reflex; the eyeball does not move; the head is not drawn back as usual; the animal remains perfectly quiet, and, on application of stronger irritation, we can convince ourselves of *the complete anæsthesia of the cornea and conjunctiva.* In this way I have scratched and transfixed the cornea of my animals used for experiment, with needles, and have excited them with electric currents so strong as to cause pain in my fingers and become quite intolerable in the tongue; I have cauterized the cornea with the nitrate-of-silver stick until it became milky-white. During all this the animals did not move. The last experiment convinced me that the anæsthesia involved the whole thickness of the cornea, and did not affect the surface only. But if I incised the cornea, the animals manifested intense pain when the aqueous humor escaped and the iris prolapsed. I have been unable, hitherto, to decide by experiments on animals whether or not the iris could be anæsthetized by dropping the solution into the corneal wound, or by prolonged instillations into the conjunctival sac, for experiments to test the sensibility of non-narcotized animals are very complicated and difficult, and do not yield unambiguous results. The last question which I subjected to experimentation on animals—viz., whether or not the inflamed cornea could be anæsthetized by cocaine—was answered in the affirmative. The cornea, in which I had previously induced acute keratitis, became as insensible as a healthy one. Complete anæsthesia of the cornea, from the use of a two-per cent. solution, lasts ten minutes, as an average. After such successful experiments on animals I did not hesitate to apply cocaine to the human eye also, trying it first on myself and some of my friends, then on a great number of other persons, obtaining, without exception, the result of a perfect anæsthesia of the cornea and conjunctiva. The course of the phenomena is as follows: If some drops of a two-per cent. solution are instilled into the conjunctival sac, or, better still, let run over the cornea, first a slight burning (accompanied by some lachrymation) is felt, which, in from a half to one minute, disappears, being followed by a dull sensation of dryness.

The eye, like that of the animals mentioned above, assumes a staring look, owing to a considerable dilatation of the palpebral fissure. If now the cornea is touched with the head of a pin, no sensation of pain or of contact is experienced, and all reflexes are absent. The same holds true of the conjunctiva, in which the sensation of temperature is likewise abolished. The scleral conjunctiva can be grasped with a pair of toothed forceps, or a dimple can be made into the cornea by pressure, without any unpleasant sensation or the least reflex on the part of the person thus treated ; the only thing he perceives is an indistinctness of objects, owing to the curvature of the cornea. This complete anæsthesia lasts from seven to ten minutes, then passes through a longer stage of reduced sensibility into the normal condition. About fifteen or twenty minutes after the instillation, the pupil begins to dilate. The dilatation reaches its highest degree within the first hour; decreases considerably in the second hour, and disappears, without a trace, in a few hours more. The pupil is never *ad maximum* dilated ; responds promptly to light and convergence during the whole time, and, for that reason, the sensation connected with atropine-mydriasis, of being dazed, is totally absent or only slightly pronounced."

A very insignificant paralysis of accommodation appears and disappears with the dilatation of the pupil. A two-per cent. solution produces no irritation of any kind, and its effects disappear in from fifteen to twenty minutes. When it is required to produce an anæsthetic effect without dilating the pupil, the cocaine is combined with pilocarpine.

On Mucous Membranes.—Cocaine produces an anæsthetic effect when applied to any mucous membrane. The cocainized area becomes pale, blanched, and finally almost bloodless, so that the sensory nerves, being deprived of their due supply of blood, cease to communicate impressions. There is first a loss of sensibility to pain, then to changes in temperature, and finally tactile impressions are lost. The nerves of special sense also fail to perform their respective functions. Thus, when cocaine is applied to the mucous membrane of the nose, the appreciation of smell is lost; and in the same way, when a solution is painted on the tongue, there is loss of taste. The effect, however, is only temporary, and passes off in from twenty minutes to half an hour. It is probable that cocaine acts by paralyzing the terminal twigs of the sensory nerves as well as the sensory end-organs, although, possibly, the effects may be due to a purely vaso-motor action.

On the Skin.—The action of cocaine on the unbroken skin is much less marked than when applied to mucous membranes, the explanation being that it is less readily absorbed. Local anæsthesia may be induced by injecting the drug hypodermically.

On the Nervous System.—When taken internally, cocaine exerts first a stimulating, and then a paralyzing action on the nerve-centres. It affects first the cerebral hemispheres, next the medulla, and lastly the spinal cord. On painting the exposed motor-areas of the brain with a solution of cocaine, their excitability is lessened, and epileptiform convulsions are produced, by the local application of the Faradic current, with much greater difficulty than in the normal condition. In large doses, cocaine may give rise to fulness of the head, a sense of weariness and restlessness, and inability to control the ideas, often accompanied by giddiness. In the case of dogs, cocaine produces a curious condition of delirium which may be described by the word ecstasy. An animal which is habitually calm, quiet, and self-contained, soon after an injection of cocaine will frisk about and display every indication of affection and delight. This continues for some hours until, little by little, the normal condition is resumed. When the dose administered is very large, the dog is dejected and may be seized with an attack of convulsions. It appears that these large doses exert a peculiar effect on the semicircular canals, due, probably, to production of anæsthesia of the nerves connected with them. This is shown by rhythmical movements of the head, disturbance of equilibrium, loss of co-ordination, rotary convulsions, and opisthotonos. The convulsions are undoubtedly of cerebral origin, for they cease when the cord is divided.

On Respiration.—H. C. Wood and D. Cerna have shown that cocaine is, in dogs, a powerful respiratory stimulant, increasing the amount of air taken into and expelled from the lungs. It exerts this action by a direct influence on the nerve-centres which preside over respiratory movements. In this respect it is allied to strychnine and atropine.

Minor Actions.—Cocaine contracts the blood-vessels and stimulates the heart, heightening blood-pressure. It lessens most of the secretions—the saliva, gastric juice, etc. —as shown by impairment of digestive power, and other examples. Peristaltic movements of the intestines are at first increased, but at length become sluggish. A slight rise of temperature has also been found to follow the administration of cocaine.

Cocaine is probably eliminated, for the most part, by the kidneys; and, after large doses, albumin and sugar have been detected in the urine.

THERAPEUTICS.—Cocaine has been employed with success in the treatment of a large number of very different morbid conditions. It is not readily absorbed by the unbroken skin, but a ten-per cent. solution in oil of cloves, rubbed into the affected part, affords relief in neuralgia. When applied to a blistered surface, it anæsthetizes the part. When injected hypodermically in doses of a third of a grain, it produces some local anæsthesia, but the action of the drug does not extend far. This mode of treatment has been found useful in neuralgia, and for the performance of small operations.

When the larynx, uvula, and adjacent parts are painted with a twelve-per cent. solution, polypi and other growths can be removed without pain. This same solution may be used with advantage in cases of acute and chronic laryngitis.

In acute tonsillitis, a four-per cent. solution should be used, and if this is applied every hour, the pain and difficulty in swallowing are speedily relieved.

A ten-per cent. solution, applied with a brush to the nasal mucous membrane, is an excellent remedy for hay-fever, and even better results may be obtained by introducing a quarter-grain tablet into each nostril, allowing it to slowly dissolve in the secretions.

In operating for nasal polypi, a four-per cent. solution is used, and is applied by means of a pledget of cotton. Catheterization of the Eustachian tube through the nose is greatly facilitated by previously applying cocaine to the lower nasal passages and to the pharyngeal orifice of the tube. This can be done by an atomizer, by a brush, or by a small swab of absorbent-cotton at the end of a probe.

Instillations of cocaine into the external ear-canal have been found useful in neuralgic earache. In inflammatory earache of children, a four-per cent. solution answers admirably, a few drops being applied directly to the drum-membrane with a speculum and dropper.

Cocaine is useful in dental practice, and it is not a bad plan to paint the gums with a ten-per cent. solution before removing tartar from the teeth. The citrate of cocaine, worked up into a little pill and pressed into the cavity of a decayed tooth, is used by dentists in dealing with a sensitive tooth-pulp.

In ophthalmology, cocaine is of the greatest value. Cataract-operations, under its influence, are performed painlessly and with very little bleeding, whilst operations on the cornea and conjunctiva are much facilitated by cocaine anæsthesia. In squint-operations, it is usually necessary to inject, with a fine hypodermic syringe, a few drops of a four-per cent. solution, through the cocainized conjunctiva, into the muscle which it is desired to tenotomize. If, in any operation, cocaine-mydriasis is inconvenient, it may be corrected by the instillation of a drop or two of eserine solution, which will produce full contraction of the pupil without diminishing the anæsthetic effect of the cocaine.

A few drops of a two-per cent. solution, injected into the urethra, will relieve the scalding of gonorrhœa. The bladder should be previously emptied, and the solution should be retained for some minutes. In the itching of herpes of the penis, cocaine applied locally affords prompt relief.

Given internally, cocaine has been found useful in the treatment of a craving for alcohol or morphine; but care must be taken not to prolong its use so as to establish a cocaine-habit. It is largely employed for the relief of sea-sickness.

A good coca wine may be made by macerating the dried coca leaves for six days in any red wine, the proportions being six parts of the leaves to one hundred parts of the wine. As good leaves cost only about a shilling a pound, this is a cheaper method than buying the advertised preparations, let alone the question of purity.

Extractum Cocæ Fluidum is official in the U. S. Pharm.

JABORANDI

The words *jaborandi*, *jamborandi*, and *iaborandi* are employed in Brazil to denote any tree or shrub possessing the power of inducing salivation and perspiration; a species of pepper—*Piper Jaborandi* or false jaborandi—being especially so designated. Practically, we now employ the term jaborandi (pronounced as if it were spelt -dy) to denote the leaves and young shoots of *Pilocarpus pennatifolius*, a member of the rue family and a native of Brazil. The true leaves are full of pellucid dots, easily recognized by holding the specimen up to light. The leaves of other species of *Pilocarpus* are frequently imported from Rio Janeiro, but they are much less active. The true jaborandi is a shrub about four feet high, obtained chiefly in the neighborhood of Pernambuco, where it grows in the forest-clearings on the slopes of the hills. It has long been employed by the natives as a remedy for snake-bite and in the treatment of fevers. Early in the year 1874 it was introduced to the medical profession, in Europe, by Dr. Coutinho, of Pernambuco, who sent specimens to the late Professor Gubler, by whom it was tried in Paris.

ACTIVE PRINCIPLES.—Jaborandi contains four alkaloids:

Pilocarpine represents the active properties of the plant, and is a liquid alkaloid, like coniine and nicotine. It is a colorless, odorless, syrupy fluid and, like other alkaloids, forms salts. On the Continent, the hydrochlorate is preferred, but it is slightly deliquescent and does not keep so well in a damp climate as the nitrite.

Jaborine is possibly a derivative of pilocarpine. It does not form crystallizable salts, and in its action is antagonistic to pilocarpine, being analogous in action to atropine and other members of that group.

Pilocarpidine acts like pilocarpine.

Jaboridine is analogous in action to jaborine.

ACTION.—When a dose of the infusion or of pilocarpine is given to an adult, under favorable circumstances, the face, ears, and neck become, in a few minutes, deeply flushed (although never so intensely as with nitrite of amyl), and soon drops of perspiration break out all over the body, while at the same time the mouth waters. Perspiration rapidly increases, the sweat running down the body and soaking the clothes, and salivation becomes so profuse that the saliva pours from the mouth in an almost continuous stream.

Jaborandi promotes other secretions, as the lachrymal, nasal, bronchial, and intestinal, although to a far less extent than the salivary and cutaneous. The eyes water, there is a little running at the nose and, perhaps, a loose cough. Nausea and vomiting may occur; but they are rarely distressing, and may be obviated by directing the patient not to swallow the saliva, but to expectorate it. Sometimes there is a little depression, due to the nausea, but it is transitory.

It is often said that jaborandi is a diuretic, but such is not the case; it is true that after the administration of a full dose the patient experiences a desire to pass water, but this is due to contraction of the bladder and not to increased action of the kidneys. The proof of this is that the amount of urine voided is very small, often amounting to only one or two ounces. Jaborandi tends rather to diminish the amount of urine excreted in consequence of its diaphoretic action, and it certainly is not a diuretic.

It has been stated that jaborandi relaxes the bowels, but this is rarely observed. There is, not infrequently, a little frontal headache; but this soon passes off, and the patient becomes drowsy and falls comfortably asleep. After a full dose the sight is a little dim, due, possibly, to the lachrymation, but there is no alteration in the size of the pupil. It is probable (judging from analogous action on salivary glands) that jaborandi stimulates the pancreas, and it is known that it increases the flow of milk. Pillicier noted, in a dog with gastric fistula, an augmentation of the gastric juice, and Rutherford's experiments have demonstrated that jaborandi is a feeble hepatic stimulant.

Occasionally there is little or no perspiration, and more frequently salivation is absent; but when the drug fails to produce sweating it acts more powerfully on the salivary apparatus, and *vice versa.* In a series of experiments by Ringer and Murrell, upon out-patients, it was shown that, of sixty-eight cases, both perspiration and salivation occurred in fifty-nine; in five, there was perspiration without salivation; in four, there was salivation without perspiration. In by far the greater number of cases, both perspiration and salivation were profuse, but sometimes the perspiration or salivation, or both, were slight. When administered in a full stomach, the drug is more slowly absorbed and the effects are less constant.

The sweat produced by a single dose of jaborandi or pilocarpine is often enormous in quantity, amounting, not infrequently, to half a pint or more. Usually the chlorides are in excess, carbonates and phosphates are present in very minute quantities, while urea exists in more than five times the normal proportion—the amount eliminated in a single sweating ranging from ten to fifteen grains. Pilocarpine produces sweating by its action on the peripheral nerve-apparatus, and not by any influence on the sweat-centres in the cord.

Pilocarpine, given by mouth or hypodermically, so as to induce sweating, has, undoubtedly, the peculiar property of stimulating growth of the hair. In one case, as the result of continued use of the drug, the hair became coarser in texture and much darker in color.

The saliva secreted may measure a pint, or even a pint and a half. Salivation is the result of a direct action on the salivary gland itself, or on its nerve-peripheries, and is produced even after section of all the salivary nerves. In large doses, it paralyzes the ends of the secretory nerves, so that irritation of the chorda tympani no longer gives rise to secretion. Langley has shown that, in proportion to the quantity given, pilocarpine paralyzes both the chorda, and sympathetic secretory-fibres. Diminution of the pilocarpine secretion, caused by stimulating the sympathetic, is a direct effect of the diminished blood-supply, and not of the nerve-fibres inhibitory to the secretion. The slight increase of saliva obtained by stimulating, after a large dose of pilocarpine, is due, not to the action of its secretory, but of its vaso-dilator fibres.

Pilocarpine is a galactagogue, and is probably the only example of this class we possess. It distinctly increases the secretion of milk by nursing women, a fact which has been demonstrated experimentally. It will be remembered that belladonna and members of that group promptly arrest milk secretion.

Its influence on the temperature is slight, and there is commonly a slight fall, due to loss of heat by evaporation.

There is generally a quickening of the pulse, amounting to forty or fifty beats in the minute, accompanied by a slight falling off in strength.

Flushing of the face is due to dilatation of the arterioles, which may account for the increased rapidity of heart-action. In frogs, the heart is not quickened, but is slowed, and is ultimately arrested in diastole, probably by stimulation of the intra-cardiac inhibitory-apparatus.

Locally applied, it produces contraction of the pupil and tension of the accommodative apparatus, with approximation of the nearest and farthest points of distinct vision and amblyopic impairment from diminished sensibility of the retina. Pilocarpine is frequently employed as a substitute for eserine.

Jaborandi affects children far less powerfully than it does adults. Compare this with the susceptibility of children to opium, and their insusceptibility to the action of belladonna, atropine, and other mydriatic alkaloids.

ANTAGONISMS.—A marked antagonism exists between atropine and pilocarpine. Atropine dilates the pupil, pilocarpine contracts it. Atropine dries the skin and mouth, while pilocarpine induces perspiration and salivation. A hypodermic injection of a hundredth of a grain of sulphate of atropine will immediately arrest the salivation and perspiration induced by jaborandi or pilocarpine. The antagonism may also be demonstrated on the frog's heart. The animal having been pithed and the heart exposed, the application of a few drops of a solution of pilocarpine first retards its action, and then arrests it in diastole. If, now, a drop or two of a solution of atropine be applied, the heart almost immediately commences beating, and continues to do so with unabated vigor. It is noteworthy that in man there is, in some respects, not only no antagonism, but the symptoms produced are similar. They both produce flushing of the face, frontal headache, and a desire to urinate. Atropine checks not only the antagonistic effects of pilocarpine, but also those symptoms which are common to both. Atropine is a much more powerful alkaloid than pilocarpine, and is more markedly antagonistic to pilocarpine than pilocarpine is to atropine. It will be remembered that both drugs act less powerfully on children than on adults.

Hyoscyamus and hyoscyamine also antagonize the action of jaborandi and pilocarpine.

It has been shown experimentally, by Ringer and Murrell, that pituri (*Duboisia Hopwoodii*), duboisine (from *Duboisia myoporoides*), and muscarine (the active principle of poisonous mushrooms) are all antagonistic to pilocarpine in their action on the frog's heart.

THERAPEUTICS.—In large doses, pilocarpine has been used with advantage in Bright's disease. It is usually given hypodermically, and the profuse sweating which it induces often relieves œdema of the extremities.

In small doses—a tenth of a grain in the form of a pilule—pilocarpine promptly relieves the night-sweating of phthisis.

Extractum Pilocarpi Fluidum is the U. S. Pharm. official preparation.

QUASSIA—CALUMBA—GENTIAN—ETC.

These are all stomachics, stomachic tonics, or bitters—that is to say, medicines which are supposed to improve appetite, assist digestion, and prevent flatulence and discomfort. Other members of the group are chiretta, cusparia, cascarilla, absinthe, and hops. Nux-vomica, strychnine, cinchona, and the salts of quinine might, perhaps, be included in this category; but they are not simple tonic bitters, and have special properties of their own, so that they are more conveniently considered apart.

Quassia consists of the chips, shavings, turnings, and raspings of *Picræna excelsa*, a tree some fifty or sixty feet high, growing in Jamaica and St. Vincent, and known in the West Indies as the "bitter wood" or "bitter ash." In addition to the chips and shavings, quassia is met with in the form of logs and billets, which are often as thick as the thigh. The wood is of a light-yellow color internally, and is grayish-brown externally. The chips possess the same characteristics. The wood is dense and tough; is without odor, and has an intensely bitter taste. The "bitter cups" sold by apothecaries are turned out of quassia wood.

The first account of Jamaica quassia was given by Dr. John Lindsay, of that island, in 1791. He spoke of the tree as being well-known, not only on account of its excellent timber, but as a remedy for putrid fevers and fluxes. He added that the bark is exported to England in large quantities, for the purposes of brewers of ale and porter.

Calumba is defined as being the root, cut transversely and dried, of *Jeteorrhiza calumba* (*Cocculus palmatus*), growing in the forests of Eastern Africa between Ibo and Zambesi. The pieces are ovoid, cylindrical discs, varying in diameter from one to three inches, and in thickness from an eighth to half an inch. The central portion is yellow and spongy, and on examination will be seen to be arranged in concentric layers. The outer portion has a dark-green or olive color. The slices become concavo-convex on drying, and are usually thinner in the centre. They are frequently worm-eaten, presenting a number of minute holes or apertures. Calumba root has very little odor, but an intensely bitter taste. It is held in high esteem by the natives of Eastern Africa, who call it *kalumb*, and use it in the treatment of dysentery and, in fact, for almost every disease.

Gentian is the dried root of *Gentiana lutea*, the yellow gentian which grows abundantly in Switzerland and on the Pyrenees. It is in long, cylindrical pieces, from half an inch to an inch in diameter, wrinkled, and longitudinally twisted. It is brown externally, yellow and spongy within. The name gentian is supposed to be derived from Gentius, King of the Illyrians, who flourished B.C. 180–167.

ACTIVE PRINCIPLES.—Quassia contains quassiin, a bitter, neutral principle, which is not an alkaloid. The wood contains no tannin.

Calumba contains calumbin, a neutral principle, and berberine, a yellow alkaloid which gives it its color. This berberine, or berberia, was first discovered in the common barbery, hence its name, and has since been found not only in calumba, but in various other medicinal substances, especially those combining a bitter taste with a yellow color—such as hydrastis, coptis, and podophyllum. It has nothing to do with sulphate of berberine, the tonic and antiperiodic obtained from bebeeru bark. Another principle is calumbic acid, which probably exists in the form of calumbate of berberine. Calumba contains much starch, but no tannin.

Gentian contains gentio-picrin, which gives it the bitter taste, and gentianin, which is tasteless.

PREPARATIONS.—Most infusions are made with boiling water, but infusions of calumba and quassia are made with cold water, and the infusions of chiretta and cusparia with water at 120° F. Cold water is used in the case of calumba because it contains starch, which readily dissolves in boiling water but not in cold. Infusions containing starch do not keep well; if, therefore, an infusion of calumba strikes a blue color with iodine, it shows that it contains starch and has been made with hot water. Infusion of quassia is made with cold water for another reason (it contains no starch), which is that the active principle of quassia—quassiin—dissolves as readily in cold water as it does in hot.[1]

As infusions of quassia and calumba contain no tannin, they may be given with preparations of iron without forming a black and unsightly mixture. The bitters thus available with iron are: quassia, calumba, cannella, and weak infusions of chamomile.

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[1] It will be remembered that decoctions are prepared by boiling; infusions never.

ACTION.—It is usually said that bitters increase the secretion of digestive juices, and, by their antiseptic action, prevent decomposition and flatulence. This, however, is also denied, and it is maintained by some that bitters check the secretion of the gastric and pancreatic juices, and even promote fermentation and putrefaction. It is probable that many of the bitters act as cholagogues, increasing the flow of bile.

Pure bitters differ from spices—such as coriander, cardamom, caraway, anise, ginger, and the like—by exciting no general stimulation of the mucous membrane of the stomach. Schmiedeberg, speaking of the group of simple bitters, says that their taste is the only pharmacological test for them. He adds: "One may indeed accept it as true that these substances exert a special influence on certain nervous elements which are in the walls of the stomach, and are concerned in the process of nutrition—an influence similar to that which they exert on the nerves of taste. Nevertheless, at present there is not a single genuine (experimental) proof to justify such a belief."

It is probable that, as stomachic tonics, there is little to choose between quassia, calumba, and gentian, although calumba has the reputation of exercising what is called a "soothing effect" on the mucous membrane, and is supposed to be especially indicated in convalescence from acute illnesses. Many writers maintain that calumba is more easily tolerated by the stomach than the other bitter drugs. Wood says that quassia is "probably the most active of all the bitter tonics." Schmiedeberg, on the other hand, says: "No one of these tonics has any special advantage as compared with the rest. Some physicians will prefer one, and others will prefer another." Possibly the presence or absence of tannin will influence the selection.

Quassia, in addition to its action as a bitter tonic, is very fatal to all the lower forms of animal life. On insects, it exerts a narcotic influence, and the infusion, sweetened with sugar or treacle, is often employed to destroy flies. It is also used as an injection into the rectum to destroy thread-worms.

Quassiin produces in frogs great weakness, with convulsions or convulsive tremblings, failure of respiration, and finally arrest of the heart's action.

Calumbin slightly raises blood-pressure, and, in large doses, lowers it.

Berberine, administered hypodermically to rabbits, produces a fall of temperature accompanied by signs of prostration; but given by mouth it has little or no action. Fifteen grains, administered to a man, induced colicky pains and diarrhœa.

The drugs most closely allied in general action to quassia, calumba, and gentian, are chiretta (*Ophelia chirata*), cusparia (*Galipea cusparii*), and cascarilla (*Croton eluteria*).

[The official preparations are:

Extractum Quassiæ; Extractum Quassiæ Fluidum; Tinctura Quassiæ, 10 per cent.

Extractum Calumbæ Fluidum; Tinctura Calumbæ. 10 per cent.

Extractum Gentianæ; Extractum Gentianæ Fluidum; Tinctura Gentianæ Composita, 10 per cent.]

PHYSOSTIGMA

Physostigma, or Calabar bean, is the seed of the *Physostigma venenosum*, the ordeal bean of Western Africa, used by the natives of Calabar as a judicial test. The accused, who, in the absence of more definite evidence, is usually indicted for sorcery, is conducted to the temple of justice, where, in the presence of spectators, he is invited to partake of the beans. The belief is that if they are rejected by vomiting the person is innocent, but if they are retained and prove fatal he is guilty. Under the circumstances an appeal is not possible. The result probably depends on the number of beans eaten. If the accused is innocent, he par-takes freely and without hesitation, and vomits; but if he entertains any doubt on the subject, he indulges moderately and, vomiting not being produced, he falls a victim to his over-conscientiousness. In savage duels the challenger bites a bean in two, swallows his morsel, and politely hands the other half to his opponent, who follows his example. The combatants are killed, and the result is satisfactory to everybody.

Physostigma was first raised from seed in the Botanical Gardens in Edinburgh, in 1860, and was named by Professor Balfour.

THE ALKALOIDS contained in physostigma are:

Physostigmine, or eserine, appearing as colorless crystals and forming salts, of which the best known are the hydrobromate, salicylate, and the sulphate. It represents the activity of the plant.

Calabarine, antagonistic to physostigmine and allied to strychnine, and, possibly, a derivative of physostigmine.

ACTION.—One of the first experiments with physostigma was made by the late Sir Robert Christison on himself. After taking six grains of the seed he felt no effect, with the exception of a little numbness in the legs; but on increasing the dose to twelve grains, he experienced a sensation of giddiness and drowsiness. An emetic was given, but, although it acted freely, the giddiness increased, and was accompanied by extreme faintness and great prostration. The heart was feeble and irregular, but there was neither pain, numbness, nor pricking. After the administration of stimulants Sir Robert was able to move about a little, and as he felt sleepy he was allowed to doze for a couple of hours. The sleep he describes as "conscious sleep," so that on awaking he did not know that he had been sleeping at all. The next day he had completely recovered and felt quite well. He did not repeat the experiment.

Some years ago fifty children were poisoned at Liverpool from eating the beans. The sweepings of a ship from the

West Coast of Africa were thrown on a rubbish heap, and a number of beans were picked up and eaten by several children. A boy, aged six, ate six beans, and died in a very short time. The symptoms were severe griping pains, persistent vomiting, and contracted pupils. On attempting to walk, the children staggered as if drunk.

For an accurate knowledge of the action of physostigma we are indebted, chiefly, to the observations of Professor T. R. Fraser, of Edinburgh.

Physostigma causes paralysis, the posterior column of the cord being affected before the anterior. The medulla is also paralyzed, and respiratory movements cease before the reflex action of the spinal cord is destroyed. The motor-nerves are not affected till late, and the sensory-nerves not at all, unless the drug is applied topically. The brain is not paralyzed, and may even be stimulated, for when physostigma is given to epileptic subjects the frequency of the fits is increased. Physostigma does not affect the centres of conscious impressions, and consciousness is preserved until the oxygenation of the blood is so far interfered with that carbonic acid-narcosis supervenes.

Sometimes tetanus is observed, the symptoms being similar to those of strychnine-poisoning. This is due to the action of the calabarine.

Applied locally to the eye, physostigma causes contraction of the pupil; diminishes intra-ocular tension, and produces spasm of accommodation. Contraction of the pupil results from its action on a local mechanism situated either in the iris or in the choroid. It produces tetanic contraction of the ciliary muscle in the same way that it affects the sphincter pupillæ. Movements of the iris are always accompanied by variations of intra-ocular pressure; dilatation of the pupil increasing it, and contraction of the pupil diminishing it. According to Höcker, physostigmine first increases and then diminishes intra-ocular pressure.

Physostigma acts as a stimulant to the muscle of the heart and arrests it in systole. It may at first quicken respiration, but it ultimately retards it, and death is always due to failure of respiration. All parts of the central nervous system are paralyzed by physostigma, and death takes place from stoppage of respiration, with symptoms of acute suffocation.

Physostigma exerts a marked action on involuntary muscular tissue. It stimulates the muscular tissue of the stomach, and gives rise to retching and vomiting. It increases peristaltic movements of the intestines, and may cause spasm and diarrhœa. It also contracts the spleen, the bladder, and, it is said, the uterus.

Physostigma acts as a stimulant to most of the secretions—salivary, perspiratory, lachrymal, and mucous. The increase is due, not to an action on the terminations of the secretory nerves, but to an influence on the cells themselves.

SYNERGISTS AND ANTAGONISTS.—Physostigma, in its action on the cord, is allied to gelsemium, and, in this particular, is antagonistic to strychnine and to picrotoxin; but calabarine is allied to both. In its action on the pupil and on the secretions, it is allied to pilocarpine, and is antagonistic to atropine, hyoscyamine, and other members of that group.

Atropine is the recognized antidote to physostigma. Fraser says: "The exhibition of the antidote should be persevered with in repeated doses until the pupils are fully dilated and the pulse-rate increased, and probably, also, until the hypersecretion of bronchial mucus, which freely impedes respiration, is checked."

In its action on the secretions physostigma is allied to muscarine.

An antagonism is believed to exist between chloral hydrate and physostigma. Chloral hydrate paralyzes the cord, physostigma stimulates it.

THERAPEUTICS.—Physostigma is useful in tetanus. It must be given in large doses—from two to four grains of the extract hourly; but while it is necessary to push it, its effect must be carefully watched.

In small doses, it is useful in many nervous affections, such as locomotor ataxia, writers' cramp, and paraplegia due to myelitis. One-tenth of a grain of the extract, in the form of a pill, should be given every three hours, and the treatment should be kept up for six months or longer. Improvement is slow, but the results are, on the whole, very satisfactory.

[PREPARATIONS.—Extractum Physostigmatis; Tinctura Physostigmatis, 15 per cent.; Physostigminæ Salicylas.]

CAFFEINE

Caffeine is an alkaloid usually prepared from tea-leaves (*Thea sinensis*), or from the dried seeds of *Coffea arabica*, by first making an infusion, then removing the astringent and coloring matter, and finally evaporating. It is also contained in guarana (the fruit and leaves of *Paullinia sorbilis*), in Maté or Paraguay tea (the leaves of the *Ilex Paraguaiensis*), and in the Kola nut (*Sterculia acuminata*). It will be remembered that Maté is largely employed in South America as a substitute for tea, and that similar properties are usually ascribed to guarana and the Kola nut. Caffeine may also be prepared synthetically from theobromine, an organic base existing in cacao-beans, and is then usually known as methyl theobromine. Most of the caffeine of commerce is obtained from tea-leaves. Caffeine is, chemically, tri-methyl-xanthine, while theobromine is di-methyl-xanthine.

Caffeine is capable of forming salts. It is usually in the form of light, colorless, acicular, inodorous crystals, looking somewhat like fine white silk. It is soluble in one hundred parts of cold water, and freely in boiling water. It is a very feeble base, and the salts split up on the slightest provocation. The only official salt is the citrate, but the hydrobromate and many others are easily prepared. Citrate of caffeine is a weak combination of caffeine and citric acid, and is usually regarded as a doubtful salt. It is sometimes seen in white, needle-like crystals, or masses of crystals, but is more frequently amorphous. A popular preparation is the effervescent citrate of caffeine. The physiological action of the citrate is identical with that of caffeine itself.

It is generally supposed that caffeine, theine, and guaranine are identical; and these names are recognized officially [in Great Britain] as synonyms for caffeine. Some doubt, however, exists on this subject, and Dr. Thomas J. Mays asserts that caffeine and theine are not physiologically identical, and that guaranine is a kind of half-way product between the two. Mays maintains that theine does not cause muscular rigidity, even when a muscle is immersed in a solution, but that caffeine uniformly induces this condition. Brunton and Cash fail to confirm this observation, but point out that there may be differences in the nature and, consequently, the physiological action of the active principle obtained from different kinds of tea; or even of the same tea, by different methods of extraction. Tea and coffee undoubtedly differ in their general effect on man; but very little weight can be attached to this fact, for coffee contains an empyreumatic oil which is developed in the process of roasting, and is not found in tea.

It is a noteworthy fact that most civilized nations, in addition to partaking of alcoholic beverages, resort to certain drinks which, although non-alcoholic, contain the same active principle in common. The Chinese have cultivated and drunk tea for over a thousand years. They usually take it without the addition of milk or any other substance. Russians, as is well known, usually take it with a slice of lemon, which develops the flavor, while Germans often add a dash of cinnamon or vanilla. In England, tea is, as a rule, allowed to stand too long, and the tea of the poorer classes is little more than a decoction of tannin, which is a fruitful source of dyspepsia and all kinds of gastric disorders.

Coffee, to be of any good, should be freshly-ground and, above all, freshly-roasted. When properly made it is a powerful stimulant to the nervous system. It produces an exaltation of intellectual faculties and a clearness of understanding which are distinctly pleasurable. The habit of using these nervine stimulants, when once established, is as difficult to break through as the custom of smoking, or of indulging to excess in alcohol. At the same time, it must be confessed that the benefit derived from their use is distinctly greater than the harm they do. The effects of coffee and tea are not identical, for coffee, in addition to its empyreumatic oil, contains more gum and sugar, and very much less tannin than tea.

ACTION.—In frogs, the chief symptoms induced by caffeine are: Muscular weakness succeeded by violent tetanic convulsions, general paralysis, and death by asphyxia; the heart continuing to contract after the cessation of respiration, although evidently much affected. The convulsions are purely muscular in origin, and are allied to post-mortem rigidity. When an isolated muscle is soaked in curare so as to paralyze the motor nerves, and is then treated with a solution of caffeine, the usual rigidity is developed. When, under the microscope, a muscle-fibre is touched with caffeine, it is seen to contract to half its length. It is asserted that the action on frogs varies according to the species employed. In *Rana temporaria*, it produces a rigid condition of the muscles resembling rigor mortis, especially when locally applied; but in *Rana esculenta*, its action on the muscles is slight, and the chief symptom induced is tetanus, which, like that of strychnine, is spinal in origin.

In birds, the symptoms produced by caffeine are irregular movements (due apparently to cerebral disturbance), increased rapidity and irregularity of respiration, spasmodic tremblings, and clonic convulsions.

In mammals, the symptoms are: Restlessness, hurried respiration, first a lowering and then a decided elevation of temperature, muscular weakness, tetanic and clonic convulsions, and finally death from arrest of respiration. In cats, it produces a condition of almost frantic cerebral excitement.

In man, caffeine acts as a stimulant to the higher centres. It produces heaviness of the head, flashes of light before the eyes, singing in the ears, loss of sleep, restlessness and, in large doses, delirium. It is said that under its influence the sight becomes more acute, the hearing more sensitive, and the taste more refined. In some people it exerts a stimulating and refreshing effect, promoting muscular and mental activity, and a sense of cheerfulness. In others, it gives rise to a condition of intense wakefulness, accompanied by a peculiar state which is best described by the term anxiety.

It has long been known that the group of bodies called xanthines possess diuretic properties, and this action is well marked in the case of caffeine. Brakenridge was of opinion that this action was due to stimulation of the renal glandular epithelium. Dr. C. D. F. Phillips, working in conjunction with Dr. Bradford, has shown, by experiments with the oncometer, that citrate of caffeine exerts a powerful action, both on the kidneys and on the blood-pressure. Immediately after the injection of the drug the kidney contracts, and this contraction may last for two or three minutes, whereas the fall of the general blood-pressure lasts only twenty or thirty seconds. The marked contraction of the kidney, which is, of course, due to a constriction of the renal vessels, is followed by a large expansion, which is not only much greater in amount than the previous contraction, but lasts a longer time. During the period of contraction, the flow of urine is either greatly diminished, or may even be totally arrested. During the subsequent expansion, the rate of flow is frequently trebled, and this effect persists as long as the expansion. The effect of caffeine citrate is twofold: During the first stage of its action there is a fall of general blood-pressure, and constriction of the renal vessels: during the second stage, the blood-pressure returns to its normal height, and the kidney undergoes great expansion. The last stage persists much longer than the first.

The objections to the use of caffeine as a diuretic are many. It sometimes acts as a purgative as well as a diuretic. Then, again, although at first it produces copious diuresis, tolerance is soon established and it loses its diuretic power. Moreover it is a powerful cardiac stimulant, and, in many people, exerts a very marked excitant-action on the central nervous system. Lastly, and as a minor disqualification, it sometimes sets up considerable smarting in the penis, and produces a mild form of urethritis.

There is reason to suppose that caffeine checks organic combustion and tissue-waste, although the evidence as to its influence on the elimination of urea is not conclusive.

Caffeine probably acts as a local anæsthetic, in much the same way as does cocaine.

ALLIES AND USES.—The dose of caffeine is from one to five grains; of the citrate, from two to ten grains. Many patients experience difficulty in taking the larger doses.

Tea and coffee, in general action, are allied to Maté or Paraguay tea, cacao, and guarana.

A slight modification in the chemical composition of caffeine materially alters its physiological action. In many cases caffeine (tri-methyl-xanthine), while acting admirably as a diuretic, over-stimulates the nervous system, and produces sleeplessness. Theobromine (di-methyl-xanthine), while acting equally well on the kidneys, has none of these disadvantages. It is said to be five times as active a diuretic as caffeine, but the objection to its use is that it is insoluble in water. A substance containing from forty-four to forty-eight per cent. of theobromine in combination with hydrate and salicylate of sodium, and called "diuretin," has been obtained, which is said to have no action on the heart, but to be capable of inducing a copious flow of urine so long as there is any healthy or comparatively healthy tissue for it to act on.

The chief clinical use of citrate of caffeine, apart from its action as a diuretic, is in the treatment of headache and megrim. Care must be taken to distinguish between the official citrate of caffeine, and the popular "effervescent citrate of caffeine" which contains a grain in the drachm. Serious symptoms have resulted from telling a patient to take "a drachm of citrate of caffeine," when the effervescent salt was intended, the dose of which is a drachm or more, while the dose of the official salt is from one to five grains.

[Preparations.—Caffeina Citrata; Caffeina Citrata Effervescens.]

CONIUM

By conium we mean the fruit, fresh leaves, and young branches of *Conium maculatum*, the common, greater or spotted hemlock, an indigenous plant growing wild in almost every climate, and found in abundance in hedge-rows and waste-places. The root is fusiform, like the parsnip; the stem is from two to five feet high, herbaceous, erect, round, hollow, much branched, polished, and variegated with spots and streaks of a reddish-brown color. The leaves resemble those of the common parsley.

The word *conium* is derived from κώνος=a cone or top, and is probably used figuratively in reference to the giddiness which preparations of the plant induce when taken internally.

The root is the least active portion, and, when gathered at certain seasons of the year, is almost inert. Both the leaves and the fruit have a strong, heavy odor, which is developed by the action of an alkali, and resembles the odor of mice or the urine of cats.

Active Principles.—*Coniïne*, Conine, or Conia is a liquid alkaloid, colorless when pure, and having a powerful odor of mice. This odor is characteristic, and may be detected in a solution containing not more than one fifty-thousandth part of the alkaloid. Coniine is soluble in ether and in alcohol, and slightly soluble in water. It leaves a greasy stain on paper, which disappears on warming. It forms salts with acids, which are odorless, but on neutralizing the acid with an alkali the smell at once becomes apparent. The vapor of the alkaloid is inflammable, and burns with a yellow flame, giving off a great deal of smoke.

Methyl-coniine or Methyl-conia.—This alkaloid exists in conium in variable quantities, and is often a large ingredient in commercial coniine Possibly it is a decomposition-product. Coniine is represented by the formula $C_8H_{15}N$, while methyl-conine is $C_9H_{17}N$.

Conhydrin or Condrin.—This is a solid alkaloid, and much less active than coniine.

Conic Acid is also present, but presents no points of interest.

A volatile oil is also found, which is not poisonous.

ACTION.—Conium is a most active poison, being, according to some, only second in activity to hydrocyanic acid. The effects are due to the coniine and methyl-coniine it contains. These active principles being volatile and liable to decomposition, the activity of different preparations of the plant is in the highest degree uncertain. Probably the succus is the most reliable. The quantitative relation of the two alkaloids varies much. Their actions are similar, though not identical, methyl-coniine exerting a special influence on the spinal cord, and causing paralysis of reflex action.

The action of conium on man and on the lower animals is, in the main, the same, although some herbivora—such as goats, sheep, and horses—eat the leavel with impunity.

A good idea of the general action of conium may be gathered from the account of the death of Socrates, as given by his friend and disciple, Plato. Christison, it is true, maintained that the plant actually employed was not conium, but a closely-allied species; but the description is sufficiently accurate for all practical purposes.

The chief action of the drug is on the motor-nerves, and especially on the motor extremities of these nerves. It can be shown experimentally that it is not due to any action on the muscles themselves, for they contract to galvanic stimuli, applied locally, just as freely as muscles which have not been subjected to the action of the drug. The paralysis is not due to the action of the drug on the cord, for when one leg is protected by ligature of the artery and vein, and the poison is injected, there is no paralysis in the protected limb, although the drug has full access to the cord. The reason for supposing that the drug acts chiefly on the peripheral extremity of the nerve is, that if the vessels are ligatured and the leg then cut off, leaving it attached only by the motor-nerve, the paralysis ensues more quickly in the unsevered limb than in its fellow, although the main trunk of the nerve is, in each case, equally exposed to the action of the poison. We know that the sensory-nerves are not paralyzed, for if one limb is protected from the action of the poison by ligature of the vessels, irritation of the paralyzed limb induces movements in the leg which is not protected. The brain is clearly not affected, or at all events only in a secondary degree, for sensibility—the case of Socrates to wit—remains unaffected to the last. Death ensues from paralysis of the respiratory muscles.

In cases of poisoning by conium, the pupils are dilated, and there is usually ptosis, due to paralysis of the third nerve. The dilatation of the pupil is also the result of paralysis of this nerve, and is not due to stimulation of the sympathetic. The involuntary muscles are not affected, for peristaltic movements of the intestines are observed *post mortem*. There is no direct effect on the heart, for although it soon ceases beating in cases of poisoning by this drug, its action can be maintained by keeping up artificial respiration.

Coniine is a very active, poisonous alkaloid, which produces marked paralytic and less obvious spasmodic symptoms. The former symptom depends principally on its action upon the peripheral terminations of the motor-nerves, but the causation of the latter effect is not known. Coniine does not directly influence the functions of sensory-nerves, striped muscles, or the heart. Considerable differences are met with, both in the nature of the action and in the lethal activity of various samples of the drug.

THERAPEUTICS.—Large doses of conium are useful in acute mania, tetanus, and chorea. The succus should be given in doses of from one to four drachms three times a day. The dose may be rapidly increased, and even young children will, after a few days, take six drachms hourly without the production of untoward symptoms.

Conium is closely allied in physiological action to curare.

[PREPARATIONS.—Extractum Conii; Extractum Conii Fluidum.]

RESINS AND GUM-RESINS:

ASSAFŒTIDA—AMMONIACUM—MYRRH—GUAIACUM—ETC.

In connection with this subject it is necessary to explain the meaning of one or two terms in common use:

Resins are brittle, amorphous solids; exudations from trees. They are characterized by being insoluble in water, soluble in spirit, and by softening or melting when heated, and solidifying again on cooling. They are oxidized terpenes, and consist of an acid or mixture of acids. They dissolve in alkalies, forming a kind of soap. They may be obtained from oleo-resins, such as turpentine, by simple distillation, the volatile oil passing over and the resin remaining behind; or they may be obtained, as in the case of guaiacum resin, simply by heating the part of the plant in which they are contained. The best examples of resins are those of jalap, podophyllum, scammony, and guaiacum.

Gum-resins are natural mixtures of gum and resin. When rubbed with water, the gummy matter dissolves, and the resin is suspended so as to form an emulsion.

The best examples of gum-resins are assafœtida, ammoniacum, myrrh, and galbanum.

Assafœtida is derived from the root of *Ferula fœtida*, growing in Afghanistan. It is composed of gum-resin, 65 per cent.; gum, 25 per cent., and about 4 per cent. of a volatile oil which contains sulphur, with saline matters.

Ammoniacum is an exudation from the stem of *Dorema Ammoniacum*, a native of Persia and the Punjab. It is composed of resin, 70 per cent.; gum, 20 per cent., and a volatile oil, 4 per cent., with saline matters. The oil does not contain sulphur.

Myrrh exudes from the stem of *Commiphora Myrrha*, a native of Arabia and Abyssinia.

Myrrh is composed of resin, 44 per cent.; gum or arabin, 40 per cent.; volatile oil, 4 per cent., with more or less water and salts. The resin is known as myrrhin, a substance which, by keeping, becomes converted into myrrhic acid. It is largely used as a local astringent for the mouth and gums, and is also useful as an emmenagogue; but is inferior, in this respect, to permanganate of potassium.

Guaiacum, a greenish, or reddish-brown, transparent, brittle, aromatic resin, is obtained from the heart-wood of *Guaiacum officinale* or lignum vitæ, native in Jamaica. Guaiacum resin contains no gum, and is composed chiefly of resinous acids.

These drugs, especially the first three, have a somewhat similar action; but assafœtida, probably from the fact that its oil contains sulphur, is much the most powerful. They are all stimulants, and induce a condition of general exhilaration often accompanied by headache and giddiness. They are antispasmodics, and stimulate the walls of the stomach and intestines, expelling flatus. They also increase the secretion of the mucous membrane of the intestines, and are mild purgatives, the motions being offensive in odor. In large doses, they excite nausea and vomiting, and also act as expectorants.

With the exception of guaiacum, they belong to the class which, for the want of a better name, we call "antispasmodics." Schmiedeberg groups them together under the head of "ill-smelling substances which act as neurotics." He points out that many vegetable substances, of disagreeable odor, are employed with much success when there is a general increase of sensory and motor sensitiveness. As they contain no peculiar active principle, it is probable that their virtues are attributable to their odor, and that the action is reflex in character. Wood says:

"In certain conditions of the nervous system—conditions associated with weakness rather than with simple depression—the nerve-centres appear to be more susceptible than is normal to external impressions, as well as to those impulses which originate in the cerebral centres themselves and are connected with the emotions. As a result of this state, various symptoms arise of trifling import, but often apparently severe, and always annoying. Such symptoms in their mildest form constitute the state of unrest known as 'nervousness'; in their severer type they may rise in intensity up to the wildest convulsions of hysteria. It is in this class of affections that the so-called antispasmodics are useful. As the condition which they relieve is nearly always associated with weakness, they are often spoken of as 'nerve-stimulants.' In regard to most of them there is but little evidence of their power or functional activity when administered to healthy individuals. Some of them act very slightly upon the circulation when given in very large doses, and a few when administered as freely as possible induce slight cerebral symptoms, such as vertigo. As any theory of the method in which the hysterical convulsion originates—of its immediate causes and the mechanism of its production—would, with our present knowledge, be at the best but an ingenious speculation, the safest plan in regard to the action of drugs belonging to the class now under consideration is to accept the teachings of clinical experience as to facts, and to avoid theorizing as to the way in which the results are brought about."

Other members of the group are musk, castor, valerian, and amber.

Guaiacum is probably the active ingredient in the "Chelsea Pensioner," which for many years has held a high reputation amongst old soldiers for the relief of rheumatism. There are two formulas for the preparation:

Powdered Guaiacum,	℥j. [Avoirdupois]
Powdered Rhubarb,	ʒij.
Bitartrate of Potassium,	ʒj.
Sublimed Sulphur,	ʒj.
Powdered Nutmeg,	℥ss.
Honey,	1 lb.

To be mixed thoroughly. Two large tablespoonfuls to be taken night and morning.

The other formula is :

Powdered Guaiacum,	ʒjss. [Av.]
Powdered Mustard,	ʒiij.
Sublimed Sulphur,	ʒiij.
Powdered Rhubarb,	gr. xlv.
Nitrate of Potassium,	gr. xlv.

Mix thoroughly. A teaspoonful of the powder may be taken in milk at bedtime, or sufficient honey, treacle, or glycerin may be added to form an electuary, and of this a teaspoonful may be taken.

Guaiacum has a special and distinctive action, and is now largely employed as a laxative or purgative. In most of the text-books on materia medica we are told that guaiacum resin acts as "a stimulant, diaphoretic, and diuretic." I cannot find that there is much evidence in support of this view. Wood seems to be of the same opinion, for he says: "Guaiacum is believed by some to act as a diaphoretic, and to do good by increasing the elimination of the skin ; but as I have not been able to obtain, either from medical literature or from the exhibition of the medicine, any distinctive proof of its having any such action to any marked extent, I have preferred to consider the drug as an alterative." Schmiedeberg, curiously enough, deals with it under the head of "Drugs and preparations used for all sorts of purposes, but now mostly antiquated and obsolete." I am inclined to think that its main action is as a laxative or purgative, and this view is evidently shared by Phillips, who, in his well-known work on the "Vegetable Kingdom," states that in large doses it produces "dryness in the mouth, burning in the throat, a sensation of heat in the stomach, loss of appetite, heartburn, flatulence, nausea, vomiting, and purging."

My attention was drawn to the subject some years ago by casually prescribing, for a man suffering from rheumatism, some guaiacum lozenges made up with black-currant paste. He continued taking them long after the pains had ceased, and his explanation was that they did him good by acting on the liver and bowel. He said that one or two of the lozenges, taken in the morning before breakfast, acted promptly and without inconvenience. I ordered the lozenges for others of my patients suffering from constipation and, what is conveniently called, "biliousness," and the result was equally satisfactory. The lozenges not being available for hospital use, I had a confection prepared, containing ten grains of guaiac-resin to a drachm of honey. This was curiously popular with the patients, and for the last two years I have used it extensively, not only as a purgative, but in the treatment of chronic rheumatism, sciatica, tonsillitis, dysmenorrhœa, and allied affections. The confection is unpleasant, but is appreciated by patients. At first I gave it in drachm-doses once a day, but they were not satisfied with this, and I had to increase the dose to two drachms three times a day. In this quantity it seems capable of producing the maximum of inconvenience and discomfort, and gives unlimited satisfaction. The purgative effect is very pronounced, and in one case the patient had fifty-six evacuations in the week. In another case it produced a well-marked rash, covering the arms and legs with an eruption which forcibly reminded one of copaiba. That this rash is rare may be gathered from the fact that my colleague, Dr. C. T. Fox, had seen only one similar instance. It was accompanied by intense itching, which disappeared on discontinuing the drug. Guaiacum not infrequently gives rise to a burning sensation in the throat, and to obviate this I prescribed ten grains of the resin in half an ounce of extract of malt, which answered admirably. This method of treatment is, perhaps, simply a return to the old-fashioned "Chelsea Pensioner," but it is interesting nevertheless. I am sure that a trial of guaiacum resin, as a laxative or purgative (according to the dose employed), will be found satisfactory. It is probable that if the drug were triturated with cream of tartar, sugar of milk, or some other equally inert substance, its efficacy would be increased, and it would produce the desired effect in smaller doses.

By the destructive distillation of guaiacum we get guaiacol, a substance contained in beech-wood creasote to the extent of from sixty- to ninety-per cent. It is a methyl ether of protocatechin, and, when pure, is a colorless, oily fluid, only slightly soluble in water, but soluble in alcohol, ether, glycerin, fats, and oils. Its taste and odor resemble those of creasote, but it is more agreeable to take. Of late years it has been largely employed in the treatment of phthisis, and is said to exert a curative influence on tubercular lesions in the lungs by promoting sclerotic changes. It diminishes the expectoration, lessens its purulence, and removes its fœtid odor. The following formula may be used :

Guaiacol,	ʒ i.
Compound Tincture of Gentian,	ʒ ij.
Tincture of Orange,	ʒ ij.
Brandy,	℥ ij.
Malaga Wine,	to ℥ x.

Two teaspoonfuls to be given in a tumberful of cold water, three times a day, after meals. The dose may be gradually increased.

Another mode of administration is to dissolve it in glycerin and then mix it with rum. Good results have been obtained by saturating the system with the drug, and, with this view, it is often given hypodermically. Burney Yeo speaks highly of capsules containing one and a half minims of guaiacol, a quarter-grain of iodoform, and three minims of cod-liver oil; one or two being given twice or three times a day, after meals. Foxwell's observations would indicate the desirability of increasing the dose of iodoform.

The vapor of guaiacol might be used with advantage for impregnating the air of a room in which a patient lives or sleeps. The following formula is suggested:

Guaiacol,		ʒ i.
Menthol,		
Thymol,		
Camphor,	āā	ʒ ss.
Oil of Cannella,		gtt. x.
Alcohol,	to	℥ vi.

A teaspoonful should be placed in a small metal vessel filled with water, and be allowed to evaporate slowly over a spirit-lamp.

Carbonate of guaiacol, in doses of fifteen grains, is frequently prescribed, both in phthisis and in typhoid. It is a white powder, insoluble in water, but soluble in alcohol. It may be conveniently given in port wine, and in daily doses of forty-five grains. I have seen good effects from it in advanced phthisis.

Benzoate of guaiacol, under the name of "benzosol," is recommended as a substitute for creasote, and is commonly given in five-grain doses.

Oil of amber, which is closely allied to the other members of this group, is an excellent remedy for uncomplicated whooping-cough. It may be given internally, and also rubbed freely on the back and chest.

[PREPARATIONS.—Emulsum Assafœtidæ, 4 per cent.; Pilulæ Assafœtidæ, 3 gr.; Pilulæ Aloes et Assafœtidæ, 1¼ gr.; Tinctura Assafœtidæ, 20 per cent.

Emplastrum Ammoniaci cum Hydrargyro, 72 per cent.; Emulsum Ammoniaci, 4 per cent.

Pilulæ Aloes et Myrrhæ, 1 gr.; Tinctura Myrrhæ, 20 per cent.; Tinctura Aloes et Myrrhæ, 10 per cent.; Mistura Ferri Composita, 1.8 per cent.

Tinctura Guaiaci, 20 per cent.; Tinctura Guaiaci Ammoniata, 20 per cent.; Pilulæ Antimonii Composita.]

CINCHONA AND ITS ALKALOIDS

The precise period and manner of the discovery of the therapeutical properties of cinchona bark are enveloped in obscurity. Some think that the Indians of South America knew all about it before the arrival of the Spaniards, whilst others affirm that the Spaniards investigated the matter and told the natives.

The bark was brought to Spain in 1632, but was not employed medicinally until 1639. It is usually stated that we are indebted to the Countess of Cinchon, wife of Count Cinchon Don Geronino Fernandez de Cabrera Bobadella J. Mendoza, for the introduction of the drug, which was originally known as "Cinchona Bark," or "The Countess' Powder."[1] Some ten years later it was carried by the Jesuits to Rome; one of the most active members of the order in promoting its distribution and use being Cardinal de Lugo. From this circumstance it acquired the names of "Jesuit's Bark," and "Pulvis [eminentissimi] Cardinal[is] de Lugo." In course of time it fell into disuse, but was again brought into vogue by Sir Robert Talbor, the physician to Charles II., who acquired a great reputation for the cure of ague by a secret remedy. The secret was purchased for a large sum, on Talbor's death, by Louis XIV., and turned out to be the cinchona bark.

The different species of *Cinchona* are natives of the phate into a bisulphate, which is much more soluble in water than the common sulphate [1:10]. In the United States the bisulphate is almost universally employed. Solutions of quinine present an appearance which is known technically as "fluorescence"—a peculiar sheen or shining appearance on the surface of the liquid, which is readily recognized. This fluorescence is not confined to salts of quinine, but is presented by solutions of gelsemine.

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[1] [Professor Flückiger, of Strassburg, in "The Cinchona Bark," Amer. Ed., 1884, p. 83, says: Ana de Osorio, widow of Don Luis de Velasco, and wife of Don Luis de Geronimo Fernandez de Cabrera y Boabadilla, of Madrid, the fourth Count of Cinchon, and Viceroy of Peru.]

Hydrochlorate of Quinine resembles the sulphate in general appearance ; but the crystals are somewhat larger. They are more soluble in water, dissolving in the proportion of one in twenty four.

Sulphate of Cinchonine is in the form of hard, colorless, prismatic crystals which have a vitreous appearance. It is soluble in water, but the solutions with acid are not fluorescent. Cinchonine salts are cheap, but their nauseous taste is objectionable.

Sulphate of Cinchonidine is in colorless, silky crystals, soluble in water.

The other alkaloids of cinchona are of comparatively little importance. The acids obtained from the bark are quinic acid, and quino-tannic acid ; the latter differing from common tannin only in a few unimportant chemical reactions.

THE ACTION of cinchona is, for all practical purposes, that of the alkaloids it contains, and of these alkaloids quinine may be taken as the type. The pharmacological action of this alkaloid has been pretty fully worked out, and may be summed up very briefly :

It is fatal to the lowest forms of animal and vegetable life—a fact which explains its power of retarding, preventing, and arresting putrefaction.

It checks or arrests fermentation; is a powerful antiseptic, and even dilute solutions will preserve meat, milk, butter, and other articles of food.

It lessens protoplasmic and amœboid movements, and checks the migration of white blood-corpuscles from the vessels. It also causes contraction of the spleen.

Small doses improve the appetite; but large doses check digestion and, not infrequently, cause loss of appetite, and may even give rise to nausea and vomiting.

Small doses increase the force of the circulation; but large doses weaken the heart's action, chiefly from an influence on the motor ganglia, and, perhaps, in a minor degree, from an action on the muscular substance. Large doses diminish blood-pressure, partly by paralyzing the action of the heart, and partly by paralyzing the vaso-motor centre.

Small doses act as a stimulant of the nervous system. Large doses diminish reflex action by stimulating Setschenow's centre. The sensory and motor nerves are affected only when the drug is applied locally.

It lowers the temperature and acts as an antiperiodic in malarial diseases. It induces this effect by checking oxidation. Moderate doses distinctly diminish tissue-change,[1] and lessen the amount of nitrogen and of sulphates in the blood.

In the process of excretion it stimulates the genito-urinary tract, and may exceptionally produce irritability of the bladder and urethra.

It is often said that quinine is an ecbolic and capable of producing abortion. I must have given it hundreds of times, in fairly large doses, to pregnant women suffering from neuralgia, and I have never known it to exert any action on the uterus.[2]

When quinine is given internally, in large doses, a series of symptoms is produced to which we apply the term "cinchonism," or "quininism." These doses affect the sight and hearing; excite subjective noises in the ears (as of bells ringing), and occasionally produce deafness which may be permanent, but is usually temporary and lasts only a few days. Large doses often dim the sight and cause temporary blindness. Severe frontal headache, with dull, heavy, tensive, or agonizing pain, may be experienced. The face is flushed, the eyes are suffused, and the expression is dull and stupid. These symptoms are due to the action of the drug on the brain. Sometimes quinine brings out a rash which may be followed by desquamation. Some people are peculiarly susceptible thus to the action of cinchona and its alkaloids.

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[1] [Formerly, with quin. sulph. at $5.00 to $7.00 per ounce, even moderate doses used, also, to "distinctly diminish" pocket-change.]

[2] [During parturition, however, its service in increasing the force of uterine contractions is occasionally quite useful.]

Quinine diminishes the excretion of urea, uric acid, creatinine, and of sulphuric and phosphoric acids. It is eliminated chiefly by the urine, and may usually be detected in from two to five hours after a large dose.

THERAPEUTICS.—Quinine was at one time regarded as a drug of primary importance ; but since the introduction of antipyrin and antifebrin it has lost much of its former popularity, and is now comparatively little employed [in Great Britain].

It is probable that the other alkaloids of cinchona have much the same action, differing only in degree or intensity. As regards antipyretic action, the alkaloids are pretty much on a par. They all possess febrifuge properties.

Quinine is useful in ague. A rule is to give thirty grains between the termination of the first paroxysm and the time at which the second paroxysm is due. The best plan is to give the first ten-grain dose about the end of the sweating stage, and to give the last ten-grain dose just before the next fit is due. It is not a matter of much importance in what form the quinine is given; some people take it as a powder, others like it in pills, whilst others, again, dissolve the dose in a small quantity of sherry. If it is not retained by the stomach it had better be mixed with four ounces of beef-tea or gruel and injected into the rectum.[1] Hypodermic injections of quinine are not very satisfactory, but a grain of the hydrobromate may be dissolved in six minims of water, of which the dose is from three to six minims.

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[1] [But, even so, it is apt to be repugnant to the delicate sensibilities of the average human rectum, and to result in loss of time, temper, and treatment.]

Quinine is useful in some forms of neuralgia, the indications for its use being (1) that the pain is supraorbital, (2) that it is periodic, or (3) that there is a history of malarial disease. Five grains, three times a day, usually afford relief. In all affections due to or associated with a malarial taint, it is a good plan to give quinine. Americans take very much larger doses than do English people.[1]

In neuralgia of the face, especially when branches of the fifth cranial nerve are involved, the addition of fifteen minims of tincture of gelsemium to each dose of the quinine mixture will be found an advantage. When the quinine is given in the form of a pill, a sixtieth of a grain of hydrochlorate of gelsemine should be added.

[PREPARATIONS.—Extractum Cinchonæ; Extractum Cinchonæ Fluidum; Infusum Cinchonæ, 6 per cent.; Tinctura Cinchonæ, 20 per cent.; Tincturæ Cinchonæ Composita, 10 per cent.

Cinchonidinæ Sulphas.

Cinchonina; Cinchoninæ Sulphas.

Quinidinæ Sulphas.

Quinina; Quininæ Bisulphas; Quininæ Hydrobromas; Quininæ Hydrochloras; Quininæ Sulphas; Quininæ Valerianas; Ferri et Quininæ Citras; Ferri et Quininæ Citras Solubilis; Syrupus Ferri, Quininæ et Strychninæ Phosphatum.]

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[1] [On page 327 the author mentions the considerable use, in England, of quassia, as an ingredient of ale and porter. It is well-known that these are consumed by all classes of English people, and in large quantities. If we are to understand that "half-and-half" is not only half ale and half porter, but may also be half hops and half quassia, it will be evident that English people are constantly and copiously taking bitters of one sort or another. Therefore, assuming that the action of bitter drugs generally is, in great part, due to the property of bitterness, it follows that the need for additional bitter substances, such as quinine, must be less than among people whose customs are different in this respect.]

SALICIN

Salicin is a glucoside obtained from the bark of various species of willow and other plants. It occurs in the form of white, tabular, scaly, or acicular crystals, having no odor and but slightly bitter taste. It is soluble in cold water and in alcohol. By warming with sulphuric acid, it is converted into glucose or saligenin. It was but little used in medicine until 1874, when Dr. Maclagan introduced it as a remedy for acute rheumatism.

ACTION.—Its physiological action is similar to that of salicylic acid and salicylate of sodium. It is rapidly absorbed from the stomach; but, in the blood, it speedily undergoes decomposition; saligenin, salicylic acid, and unchanged salicin appearing in the urine. Its elimination takes place slowly, salicylic acid being detected in the urine sixty hours after a single dose of salicin has been taken.

In the lower animals, large doses produce convulsions, fall of blood-pressure, and, finally, stoppage of respiration; its action in this respect resembling that of carbolic acid.

In order to produce symptoms characteristic of the drug, it is necessary, in the case of the human adult, to give one large dose of a drachm or more, or to administer half a drachm hourly. Given less frequently or in smaller doses, it induces little physiological effect. The condition of a person under full medicinal doses of the drug resembles that of a patient suffering from quininism: The expression is dull and apathetic, the face flushes on the slightest excitement, and the eyes become suffused. There is usually more or less deafness, and sense of noises in the ears. There is frontal headache, and the extended hands are tremulous. Breathing is quickened and deepened. Some of these symptoms may be absent; but the dull, heavy aspect, and the dusky flush which quickly spreads uniformly over the face, are always noticeable. With a larger dose, headache is severe, so that the patient buries his head in the pillow, and endeavors to avoid the light. There is marked muscular weakness accompanied by tremor, and a tap on the shoulder causes the muscles to contract so violently and suddenly as to jerk the arm backward. Tingling in the extremities and other parts of the body is a common subject of complaint. The voice is thick and husky, and the respiration is so hurried and deepened as to be almost panting.

Salicin, even in large doses, depresses normal temperature very slightly, if at all. The pulse is quickened, and usually becomes very weak. It renders the sweat neutral, or alkaline, and this may occur in cases of acute rheumatism if the doses given are sufficiently large.

At one time salicin was largely employed therapeutically, not only in rheumatic fever, but in chronic rheumatism, tonsillitis, neuralgia, and a number of other diseases.

If its action depends on its conversion into salicylic acid, it is clear that it can have no advantage over the latter substance. Dr. Maclagan, however, declines to accept Senator's views as to the fact of such conversion.

For a time the ill effects, which so frequently followed administration of the artificial salicylate of sodium, induced many clinical observers to revert to the use of salicin in the treatment of acute rheumatism. The observations of Professor Charteris, and the introduction of pure artificial salicylic acid and salicylate of sodium, will, in all probability, lead ultimately to the comparative disuse of salicin; although there will doubtless be differences of custom in this respect amongst physicians, the tendency being to use the preparation which, in the hands of the particular individual, has appeared to give the best results. Dr. Maclagan is accustomed to give thirty-grain doses of salicin every hour for six hours, then every alternate hour for twelve or twenty-four hours, when the pain will usually have subsided. He believes that, to do any good, it is necessary to get a large quantity of the drug rapidly into the system.

Salicin is of some value in malarial diseases, but is inferior to quinine in this respect.

OTHER USES.—Salicin, salicylate of sodium, and salicylic acid have been extensively employed for preventing the fermentation and decomposition of various articles of food. Salicylic acid, from its powerful antiseptic properties and slight taste, is especially adapted for this purpose. It is employed in very minute quantities for preserving the lighter kinds of sherry, British wines which do not contain more than ten-per cent. of alcohol, German beers, temperance beverages, lime-juice, lemon-juice, milk, cream, jam, and a variety of articles which, without the addition of some preservative, would speedily undergo decomposition.

In a case in which I was engaged, the vender was summoned before a magistrate for selling orange wine containing 0.038 per cent. of salicylic acid (equivalent to 26.6 grains to the gallon), and it was contended that such addition was injurious to health. Professor Corfield, on behalf of the prosecution, stated that the chief use of salicylic acid was as an external application, and proceeded to argue that, as salicylic acid is a useful application for corns, it must exert an injurious effect on the human organism. He omitted to state, however, that the preparation commonly employed for removing corns, is a one-in-eight solution in collodion, together with Indian hemp, and that there is a vast difference between the action of a strong solution, such as this, and the extremely dilute solution to which objection was made. I have often taken at a single dose, absolutely without inconvenience, as much salicylic acid as there is in half a gallon of this orange wine, and have not the slightest hesitation in saying that, in the proportions in which they are respectively present in preparations such as these, alcohol is a much more toxic agent than salicylic acid. If I were to take three bottles of orange wine at a dose, I would undoubtedly experience some inconvenience from the alcohol, but none from the salicylic acid. The attempt to prove that salicylic acid is a cumulative agent, and that in small doses it exerts an irritative action on the bladder, was equally futile. The fact is that salicylic acid, taken in the proportion of 0.038 per cent., even for months at a time, could not by any possibility exert a physiological action or produce any injurious effect.

IPECACUANHA

Ipecacuanha is the root of *Cephaëlis Ipecacuanha*, obtained chiefly from Brazil.

Toward the end of the seventeenth century, ipecacuanha obtained in Paris a great reputation for the cure of dysentery. A merchant named Garnier, who had been attended through long illness by a physician, as a mark of respect and gratitude made him acquainted with a drug obtained from Brazil, which was regarded as an absolute specific for dysentery. The physician, being old and disinclined to try new remedies, transferred his interest in it to his nephew, Helvetius, who, not seeing his way to making any money with it on orthodox lines, decided to run it as a patent-medicine. By dint of judicious advertising it caught on, and when the Dauphin, son of Louis XIV., contracted the disease, Helvetius sold the secret of the composition to the Court physicians for the sum of one thousand louis-d'or. Helvetius, having realized a fortune, became a respectable member of the medical profession, and wrote a learned treatise on the drug.

ACTIVE PRINCIPLES.—*Emetine* or *Emetia* is a pale-brownish, amorphous mass, sparingly soluble in water and ether, and freely soluble in alcohol, chloroform, and dilute acids. It is also obtainable in white crystals, which turn yellow on exposure to light. It does not form any distinctly crystalline salts.

Cephaëlic or *Ipecacuanhic Acid* is a glucoside allied to tannic acid.

Ipecacuanha, deprived of its emetine, is now frequently used as a therapeutical agent. This has been found of much value in treatment of dysentery, and has very decided advantage over the ordinary ipecacuanha, in not producing nausea, vomiting, and depression. It should be specially prepared, and care should be taken to see that the dried, spent marc of ipecacuanha wine is not substituted. It is usually prescribed as the pulvis ipecacuanhæ sine emetine.

ACTION.—The chief actions of ipecacuanha are as an emetic and expectorant. It is a mild, tardy, and somewhat uncertain emetic. Powdered ipecacuanha is much more efficacious than the wine. It produces repeated vomiting unaccompanied by much nausea or prostration. Nothing positive is known as to its mode of action; but it is probable that it acts on the peripheral termination of the pneumogastric. Schmiedeberg says: "Nothing certain is known about the origin of the vomiting. The idea that it is brought about reflexly, through peripheral irritation of the centripetal nerves of the digestive organs, has just as much to be said for it as the idea that emetics stimulate the centrally-situated parts, or, in other words, the centre of vomiting."

It produces an increased secretion from the bronchial mucous membrane. This may be secondary to its action as an emetic, but it is more likely that it exerts a direct influence. It has been found, in cases of chronic bronchitis, to act admirably as an expectorant when applied locally in the form of a spray.[1]

Some people are peculiarly susceptible to the action of ipecacuanha, especially when it is inhaled. This idiosyncrasy is extremely inconvenient for those who, from the nature of their employment, are brought much in contact with the drug. It is told of the wife of a surgeon, that she could always tell when her husband was making up a medicine containing ipecacuanha, by the distressing tightness in the chest which she experienced. If, by any chance, she happened to enter the surgery, even for a moment, while the drug was being powdered, she would almost immediately be affected with violent and protracted sneezing. Sometimes this was followed by shortness of breath, coughing, and spitting of blood. Sometimes the paroxysms would last for days, subsequent exhaustion being so great as to threaten her life. Sir Thomas Watson says: "I recollect a servant, employed in the laboratory at St. Bartholomew's Hospital when I was a pupil there, who had the peculiar ill-luck of being liable to this affection. Whenever the drug was under preparation he was obliged to fly the place. This idiosyncrasy is not very uncommon. A very small quantity of ipecacuanha dust is sufficient, in such persons, to bring on a paroxysm of extreme dyspnœa, wheezing, and cough, with singular anxiety and great weakness. The distress usually terminates by copious expectoration of mucus."[1]

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[1] RINGER and MURRELL: Lancet, 1874, vol. ii.

In frogs, ipecacuanha produces irregularity of the heart's action, and finally arrests it in a condition of diastole.

In mammals, especially in dogs, ipecacuanha gives rise to intestinal symptoms, and this occurs equally whether the drug be given by mouth or injected subcutaneously. The stools are blood-stained, and the intestinal mucous membrane is swollen, red, and ecchymosed, as in poisoning by arsenic, antimony, platinum, or iron. This action of the drug on the intestine is of interest in connection with its employment in the treatment of dysentery.

Ipecacuanha has the reputation of being a diaphoretic, and undoubtedly exerts this effect when given in combination with opium, in the form of Dover's powder.

THERAPEUTICS.—Ipecacuanha is usually regarded as almost a specific for dysentery. It should be given as a powder, in doses of twenty, thirty, or even sixty grains, suspended in two drachms of syrup of orange and half an ounce of water. No other fluid of any kind must be taken, and the patient should be kept lying down with a chloroform poultice on the abdomen. There may be a little nausea; but, when these precautions are observed, vomiting rarely occurs. The dose may be repeated in six or eight hours.

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[1] Some people, although unsusceptible to the action of ipecacuanha, suffer severely from like exposure to linseed or scammony. Powdered colocynth has a similar effect, and an epidemic of sneezing which occurred in a house was traced to the use of the bitter-apple, which had been powdered over the carpet and other articles, to keep out moths—MURRELL and RINGER: "Remarks on Paroxysmal Sneezing." British Medical Journal, June 16th and 23d, 1888.

This is an example of the large-dose action of ipecacuanha, and we have an equally striking example of small-dose action in the readiness with which drop-doses of ipecacuanha wine, administered hourly (or even more frequently), check certain forms of vomiting. These small doses are efficacious in the morning-vomiting of pregnancy and nursing, and of alcoholism; in the vomiting by convalescents from acute diseases; in acute catarrh of the stomach of children; in whooping cough, and in many other forms of vomiting. Half a drachm of ipecacuanha wine should be added to four ounces of water, and of this a small teaspoonful should be given every ten minutes for the first hour, and subsequently hourly, until relief is obtained. The effect of this mode of treatment is a certainty, and it will not be tried in vain.

[Preparations. — Extractum Ipecacuanhæ Fluidum; Pulvis Ipecacuanhæ et Opii, each 10 per cent.; Syrupus Ipecacuanhæ, 7 per cent.; Tinctura Ipecacuanhæ et Opii, each 10 per cent.; Trochisci Ipecacuanhæ, $\frac{1}{8}$ gr.; Trochisci Morphinæ et Ipecacuanhæ, Ipec. $\frac{1}{2}$ gr., Mor. $\frac{1}{40}$ gr.; Vinum Ipecacuanhæ, 10 per cent.]

SENEGA

Senega is the root of *Polygala senega,* a small plant growing wild in the [western and southern portions of the United States. It was introduced as a remedy during the early part of the last century, by Dr. Tennant, a Scotch physician of Virginia, who recommended its use in snake-bites and in various pectoral affections]. Senega, or seneka (sometimes called the seneka snakeroot), was at one time largely employed in this country [Great Britain], but its reputation is apparently on the wane.

Its Active Principle is senegin, identical with the saponin contained in sarsaparilla and soap-bark, and is allied to digitonin, one of the active principles of digitalis. Senegin is a white powder, soluble in alcohol, and readily forms a soapy emulsion when mixed with boiling water. It splits up, on boiling, into grape-sugar and sapogenin.

Action.—Locally, senegin acts as an irritant, anæsthetic, and muscular poison. It produces intense pain when injected subcutaneously; prolonged sneezing when sniffed up the nostrils; and vomiting, diarrhœa, and gastro-enteritis when taken by the mouth. Applied to the intestines, it paralyzes the involuntary muscle-fibres. It arrests the heart in diastole, and in this connection is antagonistic to digitalis. When absorbed, it paralyzes the nerve-centres as well as the nerves and muscles.

Therapeutics.—It is a stimulating expectorant, diuretic and, to some extent, diaphoretic. Schmiedeberg expresses a decided opinion that it is not the best member of the group to use. He thinks that in practice it would be better to employ quillia bark, instead of the nauseous and expensive senega root, as it contains the same active principles in a much larger proportion.

[Preparations.—Extractum Senegæ Fluidum; Syrupus Senegæ, 20 per cent.; Syrupus Scillæ Compositus, 8 per cent. of senega.]

GLYCERIN

Glycerin is a triatomic alcohol obtained from fats and fixed oils. It contains five-per cent., or less, of water, and is a clear, colorless, syrupy fluid; oily to the touch, very sweet, and without odor. It does not evaporate on exposure, but readily absorbs water from the air. It does not become rancid, and will not ferment spontaneously. When heated, it decomposes, giving off an acrid vapor known as acrolein. It has remarkable solvent properties; iodine, bromine, salicin, arsenous acid, carbolic acid, borax, gallic acid, tannic acid, and most of the alkaloids, dissolving in it readily. [Hence it has become useful in the United States as a solvent for active constituents of vegetable drugs, and has, to some extent, and in some cases, taken the place of alcohol.]

In the British Pharmacopœia is a class of preparations known as glycerins; mostly of a soothing, astringent, or antiseptic nature.

When glycerin is mixed with starch, it forms a plasma [glycerite of starch], which is used, among other things, for making pills, and enters into the composition of suppositories of carbolic acid with soap, tannic acid with soap, and morphine with soap. With iodine, glycerin forms iodized glycerin, which has been used as a substitute for cod liver oil in the treatment of phthisis and other wasting affections. Boroglyceride, largely employed for preserving fish, meat, and milk, is a combination of glycerin with boric acid. This is not a mere solution, as it has an acid reaction and, when mixed with an alkaline carbonate, gives off carbonic acid. Glycogelatin is a mixture of glycerin and gelatin, and is sometimes used as a basis for lozenges.

ACTION.—Large doses of glycerin, administered to dogs, produce loss of muscular strength, lethargy, vomiting, dryness of the mucous membranes, intense thirst, lowering of temperature, and death preceded by coma and convulsions. After death, intense congestion, with softening of the tissues, is found in the lung, kidneys, and intestines. These effects have not been observed in man. Small doses, administered to guinea-pigs, improve nutrition, there being a marked gain in weight accompanied by diminished excretion of urea; but in man, glycerin exerts no controlling power over the waste of nitrogenous tissues.

Glycerin has antiseptic properties, a circumstance which explains its value in the treatment of flatulence and certain forms of dyspepsia.[1] It is also a laxative, and is especially efficacious as a purgative when injected into the rectum. A glycerin suppository produces, almost immediately, copious watery evacuation of the bowel.

Plugs of absorbent cotton-wool, saturated with glycerin and inserted into the vagina, produce a copious excretion of watery fluid, and are of much value in treatment of congestion of the uterus [and its appendages]. Glycerin pessaries are also employed for this purpose, the following being a useful formula :

Hydrastin,	gr. j.
Glycerin,	ʒ j.
Gelatin,	enough to make a pessary.

This dissolves completely with the heat of the body.

Glycerin exerts a beneficial action on nutrition, but does not increase the elimination of urea. Large doses cause red urine, due to a discharge of the coloring matter of the blood.

Glycerin is absorbed from the alimentary canal, and probably undergoes oxidation. Only a small percentage is eliminated with the urine. It has practically no toxic action.

[PREPARATION.—Suppositoria Glycerini, 6 Gm. in each.]

NUX-VOMICA AND STRYCHNINE

By nux-vomica is meant the seed of *Strychnos Nux-vomica*—a tree, low in growth, irregular in figure, having shining foliage, and a native of the East Indies. The origin of the name is obvious, the word *vomica*=cavity, having reference to the concavity or hollow on one side of the seed.[2] The fruit of *S. Nux-vomica* resembles an orange.

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[1] RINGER and MURRELL: Lancet, 1880, vol. ii.

[2] A popular synonym for nux-vomica, or strychnine, is rat's-bane, from its employment as a rat-poison. Aconite is called wolf's-bane; hyoscyamus, henbane, and staphisagria is known as lice-bane. The term nux-vomica was originally applied to ignatia—the St. Ignatius' bean (*Strychnos Ignatii*). The word *strychnos* occurs in Pliny, and is probably derived from δτρωνυμι=to overthrow.

The seeds are of light-brown color, circular, flattened, about an inch in diameter and a quarter of an inch in thickness, concavo-convex, and have a projection or boss on the convex side. They have a velvety feeling from being covered with fine hairs. They have no odor, but are intensely bitter; are hard, and difficult to powder. They are often compared, as regards shape, to a Chinaman's hat, and the Germans call them "crows' eyes." The seeds average about thirty grains in weight, and one of them is sufficient to cause death.

The bark of the tree was at one time used to adulterate cusparia bark, and was known as "false angostura." The substitution occasioned much alarm and not a few accidents, and the use of angostura was prohibited in some countries. The fraud is easily detected by the brucia test —a drop of strong nitric acid giving a red color with the *Strychnos* bark but not with the angostura.

ACTIVE PRINCIPLES.—*Strychnine*, an alkaloid, was discovered in 1818, first in St. Ignatius' bean, and soon after in nux-vomica. It is known to exist in at least five species of *Strychnos*, being, in each case, associated with brucine. It is met with, either as a white powder, or in the form of crystalline particles of different sizes and of various appearance; sometimes in little pearly scales, like mica, and sometimes in octahedra. It has been more than once mistaken, with fatal results, for santonin. The amorphous form is not reliable, as it is very likely to contain brucine as an impurity. Strychnine should not give a red color with strong nitric acid—proof that it is free from brucine. It is slightly soluble in water, but its salts are soluble, and it can be readily dissolved by adding a few drops of an acid. It has no odor; but is intensely bitter, and by its taste it may be detected in a solution containing only a grain to the gallon, or in a single drop containing not more than $\frac{1}{5000}$ of a grain. It will impart its bitterness to twenty thousand times its weight of water. Nux-vomica contains from one-half-, to one-quarter-per cent of it.

Brucine, or *Brucia*, the second alkaloid, was discovered in 1819, a year later than strychnine. It is met with not only in nux-vomica and ignatia, but in other plants belonging to the same genus, the two alkaloids being always associated. The proportion of brucine in nux-vomica is less than that of strychnine, and is probably not more than one-tenth-per cent. Brucine occurs as an amorphous, white powder, or it may be in little, white, acicular crystals. It has a well-marked, bitter taste. Like morphine, it gives an intensely red color with strong nitric acid—a reaction not yielded by strychnine. It is largely used to adulterate strychnine, but the substitution is readily detected. It has about one-tenth the physiological activity of strychnine. It is not official. It is difficult to get brucine free from strychnine.

Igasurine, a third crystallizable base, is said to have been discovered in 1853, but its existence is doubtful.

These alkaloids are combined in the plant with an acid known as igasuric or strychnic acid, which is allied to malic acid.

ACTION.—The action of nux-vomica and strychnine is practically identical. Brucine has the same action, but is weaker. They act in a similar manner on almost all animals. It is found, however, that it takes ten times as much to kill chickens as it does other birds. Among mammals, guinea-pigs are very insensitive to the action of these tetanizers. The age of the animal is an important factor; the older the animal the more it takes to kill it.

When taken in quantities just sufficient to produce physiological effects, strychnine induces, in man, a feeling of restlessness accompanied by trembling in the limbs and stiffness in the neck and jaw. Dr. Anstie attributed to it the power of producing preternatural acuteness of the senses, hyperæsthesia of the surface, photophobia accompanied with flashes of light before the eyes, and an excessive sensibility to sounds.

In larger doses, the symptoms closely resemble those of tetanus. They usually come on in from twenty to thirty minutes, and are rarely delayed beyond an hour. The first symptoms are uneasiness, with restlessness and pains in the limbs. Shooting pains, like electric shocks, are experienced in various parts of the body, first in the back and then down the legs and arms. Paroxysmal, tetanic contraction of the muscles supervene, and these symptoms rapidly increase in intensity until the whole body is thrown into a condition of rigidity during the paroxysms. Respiratory movements are temporarily suspended, so that the face becomes livid and bloated, the jugular veins stand out, the eyes are staring and prominent, the jaws are firmly clenched, and the pupils are dilated. The body is bent backward, and rests upon the head and heels in a condition of profound opisthotonos. Ferrier has shown that this position is due to the different strengths of the various muscles of the body. They are all equally contracted, but the stronger overpower the weaker. The powerful extensors of the back, and the muscles of the thighs, keep the body arched backward and the legs rigid, while the abductors and flexors of the arms and fingers clench the hands and bend the arms, drawing them close to the body. The corners of the mouth are drawn up so as to produce the *risus sardonicus.* Each paroxysm lasts from a few seconds to a minute or more. Consciousness is not affected, the mind remains perfectly clear, and suffering is often very great. The paroxysms are excited by the slightest movement or touch; by a current of air, or even by a loud noise. Death usually ensues rapidly; but if the patient survives for a couple of hours from the onset of the symptoms, his chances of recovery are materially improved. The fatal termination may be due to exhaustion from the repeated attacks of convulsions, or to asphyxia from spasm of the muscles of the chest interfering with respiration. The temperature is elevated, in the case of dogs, from four to six degrees.

Strychnine-tetanus is due to action of the drug on the cord. We know that it is not of cerebral origin, for in man the mind remains clear to the last, excepting, perhaps, cases when the patient is partly asphyxiated from spasm of the muscles of respiration. It is not due to the action of the drug on the nerves or muscles, for when a frog is injected with the poison, and the sciatic nerve of one leg is cut, there is no tetanus in that limb, although both nerves and muscles are subjected to the influence of the drug. It is true that, after poisoning by strychnine, the functions of motor-nerves are depressed; that they convey impressions imperfectly; and that the muscles do not contract readily to galvanic stimuli, and soon become stiff from *rigor mortis.* This is due not so much to the direct action of the drug, as to the stage of excessive activity through which the muscles have passed during the tetanic convulsion. It is probable that a physiological, if not an anatomical, continuity exists between the nerve-cells concerned in reflex action, and that they, with their processes, form a functionally-continuous network, divisible into tracts presenting various degrees of resistance to the impulses conveyed to them by the different nerves. The action of strychnine, in intensifying reflex action, may be explained on the theory that the drug reduces and equalizes the resistance of this network, so that impulses travel over all the tracts with greater facility.

Tetanus due to strychnine differs from idiopathic, or traumatic tetanus in several important respects: In the first place, in strychnine-poisoning, the patient is seized with convulsions while apparently in the midst of perfect health, and the symptoms come on soon after a meal, or after taking something as drink. There are no premonitory symptoms, with the exception of a little feeling of uneasiness or restlessness lasting only a few minutes. In tetanus attending disease, on the other hand, there may be soreness and stiffness of the muscles of the neck and jaws for some hours before the onset of the first convulsion.

It may be well to remember that idiopathic tetanus is chiefly a disease of tropical climates, and that in cases of traumatic tetanus there is a history of some injury, such as a wound, a puncture inflicted by a rusty nail, or something of the sort. In traumatic tetanus, the symptoms set in within from five to fourteen days after the infliction of the injury.

It is difficult to suppose that strychnine-tetanus could be confounded with an epileptic attack, and the slightest attention to the symptoms would obviate the possibility of committing so serious an error. It would be almost equally impossible to mistake strychnine-poisoning for delirium tremens; for in delirium tremens the patient talks wildly, and his mental faculties are evidently obscured: while in strychnine-poisoning they are preternaturally acute, even up to the last.

In strychnine-poisoning, the muscles of the jaw are the last to be affected, trismus being secondary to spasms affecting the limbs and trunk. In the tetanus of disease, trismus comes first, preceding the general convulsive movement.

In poisoning, the muscles of the jaw are relaxed in the intervals between the spasms; while in the tetanus of disease, trismus is continuous.

In poisoning, spasm affects all the muscles of the body simultaneously; while in the tetanus of disease, rigidity commences with the jaws and gradually spreads all over the body.

In poisoning, tetanus is intermittent, there being periods of complete relaxation between attacks; while in the tetanus of disease, spasm is continuous, or if there are remissions, they are far from complete, some muscular spasm always persisting.

In poisoning, there is no epigastric pain; while in the tetanus of disease, epigastric pain is often severe, being due, apparently, to spasm of the diaphragm.

In poisoning, the patient either dies or is out of danger in a very short time—probably in a couple of hours—; while in traumatic tetanus, life may be prolonged for many days.

Strychnine is a respiratory stimulant, exerting its action on the nerve-centres which preside over respiratory movements.

Strychnine produces a decided increase of blood-pressure, due to stimulation of the vaso-motor centres. It also increases peristaltic action of the intestines.

It is eliminated with the urine, for the most part unchanged, and so rapidly that at the expiration of forty-eight hours not a trace remains. It is also eliminated with the fæces and saliva. A portion becomes oxidized and converted into strychnic acid.

Nux-vomica is allied in action to ignatia, which contains the same alkaloids ; while strychnine is allied in action to brucine and thebaine. These substances are often said to be allied in action to picrotoxin, the active principle of *Cocculus Indicus;* but the convulsions of picrotoxin are due to the action of the drug on the cerebellum and not on the cord.

Strychnine, in its action, is antagonistic to physostigma, chloral hydrate, and the bromides.

THERAPEUTICS.—In full doses, nux-vomica and strychnine are largely employed as nervine-tonics. The general custom is to give tincture of nux-vomica with an alkaline mixture, such as gentian and soda; and a solution of strychnine, in acid mixtures containing dilute hydrochloric acid, tincture of calumba and, perhaps, tincture of capsicum. It must be remembered that the solution of strychnine [Br. Pharm.] is more active than the tincture of nux-vomica, and that, as a rule, it is not advisable to go beyond five minims at a dose.

From its action as a stimulator of the respiratory-centre, nux-vomica may be given with advantage in cases of bronchitis when expectoration is difficult.

Strychnine, in large doses, is frequently employed in impotence, especially that of old men. It is so given with full doses of chloride of iron, and tincture of cantharides or tincture of capsicum are often added.

Strychnine is given hypodermically in wasting of the muscles which results from infantile paralysis; in paralysis following diphtheria; in amblyopia, and in traumatic-, and tobacco-amaurosis. From a twentieth, to a twelfth of a grain should be injected every alternate day, taking care to push the needle of the hypodermic syringe well into the muscles. A two-per cent. solution is most convenient for use, and may be made by dissolving nitrate of strychnine in distilled water. Barwell, who has had much experience in this mode of treatment, has never witnessed any toxic symptoms; but with large doses of strychnine, it is just as well to proceed cautiously, especially in the case of children.

Small doses of nux-vomica are undoubtedly useful in cases of constipation. From five to ten minims of the tincture should be added to half a tumbler of cold water, and this should be sipped slowly in the morning whilst dressing. It is certain in its action, and there will be a copious evacuation of the bowels immediately after breakfast. It acts by stimulating the involuntary muscular tissue of the intestines. Drop-doses of nux-vomica, every ten minutes for an hour, cure sick-headache, especially when accompanied by that condition commonly known as biliousness.

[PREPARATIONS.—Extractum Nucis Vomicæ, 15 per cent.; Extractum Nucis Vomicæ Fluidum, 1.5 Gm. in 100 Cc.; Tinctura Nucis Vomicæ, 3 per cent. of alkaloid.

Strychninæ Sulphas; Ferri et Strychninæ Citras; Syrupus Ferri, Quininæ et Strychninæ Phosphatum.]

BELLADONNA

Belladonna comprises the leaves and root of *Atropa Belladonna*, belonging to the natural order *Solanaceæ* or *Atropaceæ*.[1] This is a very important natural order, from a medicinal point of view, as it contains a number of plants of much value, such as:

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[1] The terms *Solanaceæ* or *Atropaceæ* are not identical, but they are very nearly. The *Atropaceæ* are now regarded by botanists as a sub-order of the *Solanaceæ*.

Atropa Belladonna—Belladonna or deadly nightshade.
Hyoscyamus niger—Hyoscyamus or henbane.
Datura Stramonium—Stramonium, thornapple or Jamestown weed.
Solanum Dulcamara—Woody nightshade or bittersweet.
Duboisia myoporoides—Duboisia.
Duboisia Hopwoodii—Pituri.
Capsicum fastigiatum—Capsicum. chilli, or red pepper.
Nicotiana Tabacum—Tobacco.

These are all, with the single exception of *S. Dulcamara*, of considerable medicinal importance, and three of them—belladonna, hyoscyamus, and stramonium—are closely allied in pharmacological action.

Belladonna will be considered first, because it is the typical member of the group. Like aconite, henbane, and a number of others, it is an [English] indigenous medicinal plant and grows wild in many counties, but it is not common near London. It is found on the moors near Yorkshire, in Kent, and in Surrey. At one time it grew so abundantly about the ruins of Furness Abbey as to give rise to the name—" Vale of the Nightshade." The words *bella donna*=beautiful lady are of Italian origin; the women (so it is said) having been in the habit of using it to dilate their pupils and enhance their charms. The name *atropa* is derived from *Atropos*—one of the evil destinies whose mission was to destroy life—and is supposed to be indicative of the fate of those who come under its influence. The name is of comparatively recent origin, the plant being formerly known as the *Solanum lethale*.

Active Principles.—There is, practically, but one active principle: the alkaloid *atropine*. *Belladonnine* is sometimes spoken of, but is of no practical importance.

The classification was formerly: Belladonna—Atropine ; Hyoscyamus—Hyoscyamine and hyoscine; Stramonium—Daturine.

Ladenburg has reinvestigated the matter, and says there are only three natural, mydriatic alkaloids:

Atropine—in *Atropa Belladonna*, and *Datura Stramonium;* Hyoscyamine—in *Atropa Belladonna, Datura Stramonium, Hyoscyamus niger, and Duboisia myoporoides;* and Hyoscine—in *Hyoscyamus niger.*

Duboisine is identical with hyoscyamine.

Daturine is a mixture of atropine and hyoscyamine.

To put it in another form: Belladonna contains atropine; Hyoscyamus contains hyoscyamine and hyoscine; Stramonium contains atropine and hyoscyamine; Duboisia contains hyoscyamine.

Atropine can be decomposed in accordance with the equation:

$$\underset{\text{Atropine}}{C_{17}H_{23}NO_3} + \underset{\text{Water}}{H_2O} = \underset{\text{Tropic acid}}{C_9H_{10}O_3} + \underset{\text{Tropine}}{C_8H_{15}NO}$$

The three mydriatic alkaloids are isomeric, each answering to the formula $C_{17}H_{23}NO_3$. They can all three be resolved, thus:

Atropine yields tropic acid and tropine.

Hyoscyamine yields tropic acid and tropine.

Hyoscine yields tropic acid and pseudotropine.

By the action of dilute hydrochloric acid on salts of tropine, a series of artificial alkaloids, or tropeïnes, is obtained. The following belong to this series:

Hydroxy-benzoyl-tropeïne,
Para-hydroxy-benzoyl-tropeïne, and
Ortho-hydroxy-benzoyl-tropeïne.

Oxy-toluyl-tropeïne, another of the series, is analogous in action to atropine, and is familiar to us as homatropine.

Another tropeïne is benzoyl-pseudotropeïne, a base found in Javanese coca-leaves. It can be prepared artificially, and, under the influence of hydrochloric acid, splits up into tropine and benzoic acid. Under the name of tropacocaine, it is employed in ophthalmic practice as a local anæsthetic.

Atropine is the tropeïne of tropic acid. Belladonnine is the tropeïne of belladonnic acid.

Action.—*On man*, the effect of a comparatively small dose is to induce dryness of the mouth and throat, and, possibly, some disorder of vision. A full dose produces great dryness of the tongue and roof of the mouth, extending down to the pharynx and larynx, giving rise to frequency and difficulty of swallowing, and exciting a hard, dry cough. The face becomes flushed, the eyes are bright and injected, the pupils are dilated, the sight is dim and hazy, and the power of accommodation for distant objects is lost. There is mental disturbance, often amounting to decided delirium ; the delusions, as a rule, being of a pleasing nature. The patient is extremely restless and cannot be kept quiet. The skin is dry, and a rash appears closely resembling that of scarlet-fever. The prominent symptoms are dryness of the throat and mouth ; absence of sweating ; a rash on the skin ; mental disturbance, and the action on the pupil.

The following table may be useful in indicating the effects produced by different doses of atropine on adults :

$\frac{1}{120}$ to $\frac{1}{60}$ of a grain—Dryness of the mouth, and thirst.

$\frac{1}{30}$ of a grain—Dilatation of the pupils, accelerated pulse preceded by diminished frequency.

$\frac{1}{20}$ to $\frac{1}{12}$ of a grain—Headache, dryness of the mouth and throat, difficulty in swallowing, alteration in the character of the voice, dryness of the skin, faintness, difficulty in walking, excitement and restlessness.

$\frac{1}{9}$ of a grain—Marked dilatation of the pupils with disturbance of vision.

$\frac{1}{8}$ of a grain—A general condition of intoxication, inability to stand upright, staggering gait, difficulty in micturating, and diminished sensibility of the skin.

$\frac{1}{6}$ of a grain—Intense apathy, unconsciousness or disturbance of consciousness, pronounced hallucinations and delirium.

On Animals.—Some animals are very little affected by belladonna and other members of the group. Pigeons and rabbits, for example, are almost unsusceptible to the action of belladonna, and atropine will not dilate their pupils. Belladonna has very little effect on horses and donkeys. (In this connection the unsusceptibility of children for belladonna will be noted.) As a rule, vegetable-eaters do not respond readily to its action; the most pronounced effect being observed in the case of flesh-eating animals.

On the Heart and Circulatory System.—In most animals belladonna increases frequency of the pulse. The first effect in man is to increase the frequency, fulness, and force of the pulse to the extent of fifty or sixty beats in the minute. Belladonna paralyzes the pneumogastric nerves. This may be due to an action on the trunk of the nerve, on its peripheral termination, or on the intracardiac inhibitory apparatus. After a full dose of atropine, stimulation of the sinus produces no effect. Applied locally to the frog's heart, it arrests it in systole. The small, pale heart of atropine contrasts forcibly with the large, black heart of aconite, which is arrested in diastole. Atropine stimulates the vaso-motor centre, and so contracts the blood-vessels and heightens arterial-pressure.

On the Respiratory System.—After the administration of large doses of belladonna, respiration is accelerated, owing to its stimulation of the respiratory centre. This stimulation is so powerful that the chest-movements become deeper and more frequent. The effect is independent of blood-pressure.

On the Nervous System.—The delirium excited by belladonna indicates its action on the cerebral cortex. The symptoms in man consist chiefly of exhilaration of the mental functions, giddiness, restlessness, and automatic, chorea-like movements. There is usually loud, disconnected talking, delirium, and raving. The delusions are of a pleasing nature, and weeping or lamentation is rare.

Belladonna exerts a special action on the cord. Fraser has shown that when a frog is injected with a thousandth part of its weight of atropine, a condition of perfect paralysis and abolition of reflex action ensues; lasts for four or five days, and is succeeded by a tetanic stage, with tetanic convulsions and excessive excitability of the reflex centres, due to an action on the cord. It has been suggested that this is the result of stimulation of the cord, with accompanying paralysis of the motor nerves. This explanation, however, is unsatisfactory, and it is probable that the action is purely spinal, the drug first abolishing and then intensifying its reflex excitability. The theory is that the normal cord exerts a certain resistive power, which is abolished as decomposition sets in, and allows the impulses to be conveyed upward and downward, without stint, giving rise to a condition of tetanus.

On the Muscles.—The voluntary muscles are not affected, and, after systemic death, respond freely to galvanism applied locally. The unsteady gait, often noticed in man, is due to an action on the cord, or on the motor nerves, and not on the muscles.

It is said that belladonna increases the contractile power of involuntary muscular tissue; but it has been maintained that the increase in peristaltic movement of the intestines is due to depression of the inhibitory branches of the splanchnics.

On the Glandular System.—One of the earliest and most notable effects of atropine is dryness of the mouth, from suppression of the secretions of the mucous and salivary glands. According to Heidenhain's hypothesis with regard to salivary glands, there are two kinds of secretory fibres—one, the proper "secretory"; the other, "trophic," causing an increase in solubility in the stored-up gland substance. On the assumption of the existence of this difference, there is ground for supposing that there is a third variety—"anabolic" fibres—causing the formation of fresh substance by the cells. After an injection of sulphate of atropine there is no increase, either in the percentage of organic substance or of salts, in the sympathetic saliva produced by stimulation of the chorda tympani, as there would be if the trophic fibres of the chorda escaped paralysis. It would seem that atropine paralyzes the trophic as well as the secretory fibres of the chorda tympani.

The lacteal nerve-terminations are paralyzed, and the secretion of milk is arrested. A similar action occurs in the case of the other secretions. The secretion of the pancreas is suppressed, and the quantity of bile poured out is lessened. The effect on the urinary secretion is somewhat doubtful.

On the Skin.—Atropine checks sweat-secretion, by paralyzing the efferent sweat-fibres which accompany the vaso-motor fibres. Stimulation of the sciatic nerve no longer evokes the secretion of perspiration in the paws of kittens.

Much difference of opinion exists as to the cause of the rash, and as to the frequency with which it appears after the administration of belladonna. Dr. John Harley affirms that "generally it is nothing more than a mere temporary rash; but in rare cases, and in persons who are liable to vascular irritation of the skin, the redness remains and its disappearance is attended by slight roughness and desquamation." He mentions two cases, in one of which "the patient was scarlet from head to foot," and another in which, after the fourth dose, there was a "scarlatinous tint of the skin." Dr. Gillespie injected a small quantity of extract of belladonna into the urethra of a patient suffering from stricture, and "in less than five minutes the patient became as red as a lobster." Schmiedeberg says: "The redness of the skin resembling scarlet-fever, so often observed, especially in the upper part of the body; and the similar color with turgescence of the features, are probably connected with increase of the frequency of the pulse, with the increase of blood-pressure caused thereby, and with the simultaneous dilatation of the vessels of the skin."

On the Eye.—Under the influence of atropine, whether applied topically, or indirectly through the circulation, the pupil is dilated, and the eye becomes bright, dry, and injected. The power of accommodation is lost, and, after large doses, intraocular accommodation also. When atropine is applied locally, so as to affect the pupil of one eye, the large amount of light entering through the dilated pupil produces contraction of the pupil of the other eye.

The pupil is normally under the control of two antagonistic mechanisms:

(α) A contracting mechanism, reflex in nature, of which the oculo-motor nerve acts as the efferent, and the optic nerve as the afferent tract.

(β) A dilating mechanism, tonic in nature, of which the cervical sympathetic is the efferent channel.

When the oculo-motor nerve, or the optic nerve, is cut, the pupil dilates from the action of the sympathetic. When the sympathetic is cut, the tonic dilating-influence ceases and the pupil contracts. On stimulating the oculomotor, or optic nerve, the pupil contracts. On stimulating the sympathetic, the pupil dilates.

Dilatation of the pupil, produced by the local application of atropine, might at first sight be attributed to paralysis of the motor oculo. This view is untenable, for, when this nerve is cut, and the pupil dilates under the influence of the sympathetic, the application of atropine produces still further dilatation. From this it follows that the drug exerts an action on some local mechanism. This mechanism is not in the ophthalmic ganglion, for atropine exerts its effect after the ganglion has been excised. It is probably situated in the iris, or in the choroid, where ganglionic cells are abundant.

Dilatation of the pupil is most marked in man and in cats and dogs, while in frogs it occurs only after large doses. It may be induced in the extirpated eye of a frog.

The paralysis of accommodation is due to the action of the drug on the terminal apparatus of the oculo-motor nerve.

Of all the tropeïne alkaloids, atropine is the slowest in producing its effect on the eye ; but it lasts a long time—even many days. Homatropine induces its effects rapidly ; but they disappear in a few hours. Hyoscyamine, in this respect, occupies an intermediate position. These differences depend, probably, on the facility of absorption of the drug and on the rapidity of excretion.

Summary.—It will be seen that atropine has a somewhat complicated physiological action, for it directly influences the functions of both the cerebro-spinal and the sympathetic nervous systems. The principal effects on the former are paralysis of the sensory and motor nerves, and excitation of the cord. By its action on the sympathetic nerves, it influences the contraction of unstriped muscles. In addition to these general actions, it influences, in a special manner, the functions of the vagi nerves and of the iris ; suspending the cardiac inhibitory-power of the former, and producing contraction of the latter.

ANTAGONISMS AND SYNERGISTS.—Belladonna, in general action, is allied to hyoscyamus and stramonium, and to homatropine and jaborine. Two minims of an aqueous-solution of homatropine—1 to 120—rapidly dilate the pupil, the effect passing off in a few hours. Homatropine produces tetanus in frogs, in much the same way that atropine does.[1] The antagonism of homatropine for muscarine is very marked. Homatropine also antagonizes pilocarpine.

Belladonna and atropine, in their actions on the secretions, are antagonistic to jaborandi and pilocarpine, and also to muscarine and to picrotoxine. Atropine is a much more powerful alkaloid than pilocarpine, so that atropine antagonizes pilocarpine more readily than pilocarpine does atropine.

On the frog's heart, atropine is distinctly antagonistic to muscarine, pilocarpine, aconitine, and to digitalin.

Belladonna and opium are, in some respects, antagonistic. This antagonism is partly real and partly apparent only. A real antagonism exists in their effects on the convolutions, on the respiratory centre, and, perhaps, on the intestines. Their antagonism on the pupil is only apparent. Opium contracts the pupil in virtue of its effects on the basic-ganglia, while the dilatation caused by atropine is due, for the most part, as already pointed out, to paralysis of the ciliary branches of the third nerve. Opium, when it induces sweating, acts on the centres, while belladonna checks it, through its action on the peripheral terminations of the nerves. This partial antagonism is of value, and atropine has been employed with success in cases of opium-poisoning.

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[1] MURRELL : Practitioner, vol. xxv., p. 252.

Closely allied in general action to belladonna is the *Duboisia myoporoides*, a tall shrub growing plentifully in the forest lands of Eastern Australia. It contains an alkaloid, known as duboisine, which is identical with hyoscyamine. The general action of duboisine is practically the same as that of atropine: It dilates the pupil, dries the mouth, arrests the secretions of the skin, gives rise to headache and mental confusion, and antagonizes muscarine and pilocarpine.

THERAPEUTICS.—Belladonna is a very valuable therapeutical agent.

In the form of the belladonna plaster, it is useful in pleurodynia, myalgia, lumbago, and allied affections. The plaster should be an active preparation, and capable of yielding enough belladonna, as absorbed by the skin from it, to induce dryness of the mouth and throat, and to excite the characteristic scarlatinal rash.

The extract, mixed with an equal quantity of glycerin, forms an admirable local application for boils, carbuncles, and small abscesses. It should be smeared thickly upon lint and applied to the part. This is also applied to the breasts, to check the secretion of milk when it is desired to discontinue nursing, and this simple precaution will often obviate danger of the formation of a milk-abscess.

Internally, in large doses, belladonna is useful in checking the paroxysms of whooping-cough. Even in the case of quite young children, ten minims of the tincture may be given every four hours. It is often presented in these cases in conjunction with the bromides. The tincture of belladonna, in this dose, is useful in checking the incontinence of urine of children, and rarely fails to afford relief.

Given at bedtime, belladonna checks the night-sweating of phthisis. Any preparation of belladonna answers equally well; but in these cases it is customary to give sulphate of atropine at bedtime, in the form of a pill, in doses of from $\frac{1}{120}$ to $\frac{1}{80}$ of a grain.

Belladonna checks many other forms of sweating, and a liniment made with eau-de-Cologne is a useful application to hands which perspire too freely in hot weather.

Small doses of belladonna are useful in the initial stage of all acute febrile diseases. A minim of the tincture, in a teaspoonful of water, should be given every ten minutes for the first hour, and, subsequently, hourly for six or eight hours. It is not a bad plan to give these minim-doses with minim-doses of tincture of aconite. The skin is moistened, there is often profuse perspiration, the pulse becomes softer and, not infrequently, the temperature falls.

[PREPARATIONS.—Extractum Belladonnæ Foliorum Alcoholicum; Tinctura Belladonnæ Foliorum; Extractum Belladonnæ Radicis Fluidum.

From alcoholic-extract of the leaves: Emplastrum Belladonnæ; Unguentum Belladonnæ.

From fluid-extract of the root: Linimentum Belladonnæ.]

HOMATROPINE

Atropine consists of tropin and tropic acid. Tropin combines with amygdalic acid to form amygdalate of tropin, and this, when acted on by hydrochloric acid, forms homatropine, of which a hydrobromate is the salt commonly employed.

The physiological action of homatropine is similar to that of atropine, but it is less powerful and less prolonged. Two minims of a 1:120 aqueous solution of the hydrobromate, dropped into an eye, rapidly dilate the pupil, and produce dimness of vision due to paralysis of accommodation. Fourteen hours later, the pupil will have nearly regained its normal size.

A toad weighing 22.5 Gm. was injected with a sixth of a grain of the hydrobromate. In twenty-five minutes it presented symptoms of paralysis in the posterior extremities, and tetanus commenced in seventy minutes. The tetanus and paralysis lasted four days, and the animal recovered completely.

The antagonism of homatropine for muscarine is very marked. A toad was pithed and the thorax opened. The heart was beating well, forty-four in the minute. On the application of a 1:4 solution of extract of muscarine, it became feeble, and pulsations fell in five minutes to twelve, in nine minutes more, to six, and in twenty-nine minutes, stopped. Homatropine was then applied; in a minute the heart commenced beating, and in three minutes it was contracting strongly, twenty-two in the minute.

Homatropine antagonizes pilocarpine. A young woman with aphonia was given an injection of a third of a grain of nitrate of pilocarpine. Whilst sweating profusely, she had an injection of five minims of a 1:60 solution of homatropine ($\frac{1}{12}$ gr.), and in three minutes the perspiration ceased. A young man was given, hypodermically, ten minims of a similar solution of the hydrobromate. In a few minutes he became extremely unsteady in his gait, and complained of giddiness. This passed off in about four hours.

Homatropine dries the mouth, and checks the night-sweating of phthisis. As an anhydrotic, it is inferior to atropine. I gave fifty hypodermic injections of homatropine, of a tenth of a grain each, to sixteen patients suffering from the night-sweating of phthisis, and although the results were good, they were not better than were obtained from the administration of either Dover's powder or picrotoxin.

Homatropine may be conveniently given in the form of a pill containing one-sixtieth of a grain. For ophthalmic work, it has many advantages over atropine, the chief one being the short duration of its effect on the eye. A sixtieth of a grain is the maximum dose which can be given hypodermically with safety.

HYOSCYAMUS

[The U. S. Pharmacopœia defines "Hyoscyamus" as: "The leaves and flowering tops of *Hyoscyamus niger* Linné (nat. ord. *Solanaceæ*), collected from plants of the second year's growth." Flückiger and Hanbury speak of it as being indigenous in most parts of Europe, Asia, and Africa, and as a weed of cultivation in North America and Brazil. In North America, it became naturalized prior to 1672, at which time Josselyn mentioned it in his "New England's Rarities discovered," as "sprung up since the English planted and kept cattle in New England."]

The popular name—"henbane"—evidently refers to its effect on fowls, *bana* being the Saxon word for slaying or destroying.[1] In Anglo-Saxon writings of the eleventh century, henbane is described under the name "henbell."

Active Principles.—Hyoscyamus has two alkaloids: **Hyoscyamine** and hyoscine. The former is obtained, also, from *Atropa Belladonna*, *Datura Stramonium*, and *Datura myroporoides.* It is isomeric with atropine and with hyoscine; identical with duboisine, and, mixed with atropine, constitutes what is known as daturine. It may be split up into tropine and tropic acid. When pure, it is in the form of snow-white masses of minute crystals, soluble in alcohol and in water. A substance sold under the name of "amorphous hyoscyamine" is a mixture of hyoscyamine and hyoscine; dark-brown in color; having a strong, disagreeable odor, and looking like an extract.

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[1] [See, also, Nux-vomica.]

Hyoscine is a syrupy, liquid alkaloid. It breaks up into tropic acid and pseudatropine. It forms salts, of which the best-known are the hydrochlorate and the hydrobromate.[1]

ACTION.—The general effects of *hyoscyamus* closely resemble those of belladonna. It dilates the pupil, dries the mouth, arrests secretions, flushes the face, and produces a rash. It gives rise to a drunken gait, and excites delirium and hallucinations; but more frequently it acts as a narcotic, inducing comatose sleep. As a rule, raging delirium is not present, but there is a desire for rest and sleep, probably due to the hyoscine it contains. Its action on the lower animals is somewhat different from that of belladonna, and it is much more fatal to birds and rabbits.

It is difficult to speak positively as to the physiological action of *hyoscyamine*, for the simple reason that most of the observations have been made with amorphous hyoscyamine, which is largely contaminated with hyoscine. The pure, crystalline alkaloid affects the secretions, heart, and vaso-motor system, just as atropine does.

The action of *hyoscine* has been carefully worked out by H. C. Wood, of Philadelphia.[2] In frogs, it produces general motor-, and reflex-paralyses, progressively increasing until death ensues from failure of respiration. There is no late tetanus. Neither the muscles nor the nerves are affected, and paralysis is due entirely to depression of the motor centres in the cord. The sensory nerves are not affected. The chief symptoms are loss of muscular power, disturbance of respiration, and stupor. There is very little effect on the circulation, death being due to asphyxia. Hyoscine does not paralyze the pneumogastrics. In man, it produces dryness of the mouth, flushing of the face, and deep sleep associated with semi-delirious mutterings and giddiness. Mydriasis is usually, though not always, pronounced. Respiration is slow and full, and is sometimes of the character known as "Cheyne-Stokes." The skin, instead of being abnormally dry, is often bathed in perspiration. It is asserted that there is a rise in temperature. There is sometimes paralysis of the muscles of the pharynx and larynx.

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[1] [It is stated that nearly all the hyoscine supplied by manufacturing chemists, at present, is derived from *Scopolia Atropoides*, and that the German Pharmacopœia has, therefore, adopted the title "Scopolamine Hydrobromate" in place of "Hyoscine."]

[2] Therapeutic Gazette, January, 1885.

THERAPEUTICS.—Hyoscyamus and hyoscyamine have much the same therapeutical action as belladonna and atropine. The extract of hyoscyamus is frequently added to purgative pills to prevent griping. Hyoscyamine is a less powerful mydriatic than atropine, and is a soporific. It differs from atropine, chiefly in being a hypnotic and not an excitant.

Hyoscine has been employed with success as a narcotic. It has been used as a sedative in cases of acute mania, in paralysis agitans, and in chronic alcoholism. It may be given, as a hydrobromate, in doses of from $\frac{1}{300}$ to $\frac{1}{100}$ of a grain. Wood finds it useful in controlling all forms of sexual excitement, and says that seminal emissions can always be checked by the administration of a pill containing from $\frac{1}{120}$ to $\frac{1}{80}$ of a grain at bedtime. The mydriatic effect of hyoscine is associated with paralysis of accommodation, and the maximum effect is produced in a third of the time required by atropine. Its influence in producing sleep is very marked, and it frequently answers well when morphine causes excitement. Nausea, constipation, and other disturbances of the stomach and alimentary canal are rarely witnessed. Hydrobromate of hyoscine is used hypodermically in doses of from $\frac{1}{300}$ to $\frac{1}{100}$ of a grain. It should be employed with caution. Being tasteless, it can be administered by the mouth without difficulty.

[PREPARATIONS.—Extractum Hyoscyami ; Extractum Hyoscyami Fluidum ; Tinctura Hyoscyami, 1 Gm. in 6.67 Cc.]

STRAMONIUM

Stramonium (*Datura Stramonium*) or thornapple is commonly met with on waste ground near gardens or habitations. Some doubt exists as to its native country, and its early distribution has been much discussed by writers on botany. Some think that it came originally from America, where it is known as the Devil's apple or Jamestown weed, whilst others favor the view that it came from the borders of the Caspian Sea. It was cultivated in London, toward the close of the sixteenth century, by Gerarde, who received the seeds from Constantinople. There are two varieties of this species of *Datura*—one with a green stem and white flowers, the other with a dark-reddish stem, minutely dotted with green, and purple flowers striped with deep-purple on the inside. The last form is sometimes regarded as a distinct species, and is said to be identical with the *Datura tatula* of Linné. Naudin maintains that there can be no doubt as to the existence of two distinct species, for he crossed them and obtained hybrids twice the size of their parents, but in every other respect intermediate in character. Moreover, on cultivating these hybrids, they exhibited a constant tendency to revert to their original forms.

Datura fastuosa is largely used for criminal purposes. The professional poisoners who use the drug are known as "*daturiahs*," and some of them are said to be in quite an extensive way of business. The plant grows wild, and they have no difficulty in obtaining it. They generally use the powdered seeds mixed with flour, so that it is readily added to food. In special cases they prepare an extract or essence by distillation. Sometimes they give a toxic dose so as to kill outright, but in others they simply hocuss the victim, and, after robbing him, leave him to die from exposure. These daturiahs are the legitimate descendants of the Thugs, or phansigars, a brotherhood of murderers and robbers who waylaid people and strangled them.

ACTIVE PRINCIPLE.—Stramonium contains an active principle, known as daturine, which is not a simple body, but a mixture of atropine and hyoscyamine.

ACTION.—The physiological action of stramonium is identical with that of belladonna, whilst daturine has the same action as atropine. The symptoms of poisoning by stramonium differ in no respect from poisoning by belladonna. "The same accelerated pulse, the same elevation of temperature, the same wild delirium, the same increased frequency of respiration, the same widely dilated pupils, the same red efflorescence on the skin, the same restlessness or convulsions occur in both cases, and, when the dose has been sufficiently large, end alike in abolition of the functions of circulation, respiration, and innervation—stupor, general paralysis, and weak, rapid, thready pulse, and threatened asphyxia constituting the phenomena of the closing scene in poisoning for either narcotic."—H. C. Wood.

THERAPEUTICS.—There is one respect in which, practically, stramonium differs from belladonna, and that is in its therapeutical application. The greatest use of stramonium is as a remedy for asthma, the smoking of datura having been introduced by General Gent, in 1802, from India, where it was in use under the native name of *gharbhah*—meaning "forgetfulness of home," evidently in reference to its physiological action. It soon obtained, as most new remedies do, the reputation of being specific and infallible, and every one with anything like shortness of breath, took to smoking datura and lauding the new drug with the strange name of Sanskrit origin. As the late Dr. Hyde Salter says : "Its use has illustrated the general inapplicability of any one remedy to all cases of a disease, and the special caprice of asthma; time has shaken it into its proper place and assigned it its true worth ; its original reputation greatly exaggerated its merits, but it will probably always maintain its place amongst the remedies for asthma." It is said that *D. ferox* gives better results than

D. tatula, and that the latter is more efficacious than *Datura Stramonium.*

In this connection it may be as well to mention some other remedies, the fumes of which are inhaled for the relief of asthma :

Nitre Papers.—These are commonly prepared by making a saturated solution of nitrate of potassium in boiling water, and dipping in it pieces of thick, white blotting-paper. When dry the paper is allowed to burn slowly at the bedside, and is efficacious in relieving the paroxysms of asthma. The dense, white fumes given off contain carbonic acid, nitrogen, cyanogen, ammonia, watery vapor, and a little sublimed nitrate of potassium.

Nitre Tablets.—These consist of folds of blotting paper six inches square, prepared by steeping them in a hot, saturated solution of nitre and chlorate of potassium. They should be dried slowly before a fire, or, better still, in the open air. Iodide of potassium may be added if necessary, and, when quite dry, they may be sprinkled with Friar's balsam, spirit of camphor, tincture of sumbul, or tincture of stramonium. The tablet is folded across, so that it assumes the shape of a tent or the half-open cover of a book. When lighted, it burns briskly, producing dense masses of smoke. These tablets are useful in asthma and chronic bronchitis, and also in the treatment of insomnia.

Ozone Papers, a much advertised preparation, probably contain iodide of potassium in addition to nitre.

Asthma Pastilles are made in cones, and consist of equal parts of nitre, chlorate of potassium, and lycopodium. They burn slowly.

Himrod's Cure, Green Mountain Cure, Hockin's Cure, and *Bliss' Cure*, probably consist of powdered stramonium leaves, lobelia, and black tea, saturated with a solution of nitre. They may be closely imitated by taking two ounces each of stramonium, lobelia, and black tea and, after finely powdering, saturating them with a solution of two ounces of nitre in two ounces of water. When well-dried, this powder burns freely, giving off fumes which are useful in asthma. In some cases powdered fennel is added with advantage.

The following are good formulas for fuming inhalations, the ingredients in each case being powdered :

I

Nitrate of Potassium,	jss.
Anise,	℥ j.
Stramonium Leaves,	℥ ij.
Sumbul,[1]	ʒ j.

II

Nitrate of Potassium,	℥ jss.
Anise,	ʒ j.
Fennel,	℥ j.
Stramonium Leaves,	ʒ ij.

III

Nitrate of Potassium,	℥ jss.
Anise,	ʒ j.
Stramonium Leaves,	℥ ij.
Benzoin,	ʒ j.

IV

Lobelia,[2]	equal parts.
Stramonium Leaves,	
Black Tea,	
Nitrate of Potassium,	

The various forms of incense sold for ecclesiastical purposes may be found useful thus in the treatment of bronchitis and asthma. The following are the best formulas:

I

Storax,[3]	ʒ v.
Benzoin,	℥ iij.
Sumbul,	ʒ j.
Frankincense,[4]	ʒ v.

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[1] [Root of *Ferula Sumbul* nat. ord. *Umbelliferæ.*]

[2] [Leaves and tops of *Lobelia inflata* Linné nat. ord. *Lobeliaceæ.*]

[3] [Balsam prepared from inner bark of *Liquidambar orientalis* nat. ord. *Hamamelaceæ.*]

[4] [Gum-resin from the stem of several species of *Boswellia.*]

II

Powdered Cascarilla,[1]		℥ j.
Storax,		
Benzoin,		
Frankincense,		
Myrrh,		
Burgundy Pitch,[2]	āā	℥ ss.

III

Olibanum,[3]	℥ ij.
Benzoin,	℥ j.

[PREPARATIONS.—Extractum Stramonii Seminis; Extractum Stramonii Seminis Fluidum; Tinctura Stramonii Seminis, 1 Gm. in 6.67 Cc.; Unguentum Stramonii, 1 per cent. of extract.]

CANNABIS INDICA

Cannabis Indica or Indian hemp consists of the dried flowering tops of the female plants of *Cannabis sativa.* Hemp, from which the resin has not been extracted, is employed, and that, only, which is cultivated in East India. Hemp grown in this country [Great Britain] has no active medicinal properties. American hemp was at one time supposed to be inert, but it is now known that some hemp grown in Kentucky is active. The "tops" consist of one or more alternate branches with the remains of the flowers, a few ripe fruits, and small leaves, pressed together in masses or bundles about two inches long, of a greenish color and peculiar odor.

Several forms of Indian hemp are met with in commerce:

Gunjah, or *Gánja*—the stems, leaves, and flowers packed together in bundles. This is the form in which it is sold in the bazaars of Calcutta for smoking.

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[1] [Bark of *Croton Eluteria* nat. ord. *Euphorbiaceæ.*]

[2] [Prepared resinous exudation of *Abies excelsa* nat. ord. *Coniferæ.*]

[3] [Same as Frankincense.]

Bang or *Bhang* consists of the dried leaves, which are of a deep-green color, and usually broken so as to form a coarse powder.

Haschish, the form used by Arabs, generally met with in coils. It is from this term that we derive our modern word assassin. Eastern potentates formerly dosed their fanatic followers with this preparation.

Churrhus or *Charas*, a greenish-brown, moist, resinous mass, having the peculiar odor of the plant and consisting of resin mixed with the hairs and fragments of the leaves.

Cannabis Indica, under these different names, has been used in the East from a very early period; but whether its properties were first recognized in Persia or in India it is difficult to determine. On festive occasions, large quantities are consumed by almost all classes of Hindus. The Brahmins sell sherbet, made with *bhang*, at the temples, and religious mendicants collect *gunjah* for smoking. Shops for the sale of various preparations of Indian hemp are to be found in every town and are much resorted to.

Active Principle.—The resin, on which the peculiar properties of the drug depend, is soluble in alcohol and in ether, but separates from its solutions on the addition of water. This resin has received the name of cannabin, and has a bitter taste and characteristic odor. Tannate of cannabin is a yellowish-brown powder, having the taste of tannic acid. It is reputed to be hypnotic; but it is not a very active substance, and may be given in doses of from two to ten grains with perfect safety. In addition to the resin the drug contains a small quantity of volatile oil.

Preparations of this drug are, as a rule, unreliable, and no confidence should be placed in any particular specimen unless its physiological action has been tested. The name goes for nothing.

Action.—Indian hemp is employed chiefly for the production of its intoxicating effect. It may be used in any of the forms already mentioned, but haschish is the favorite. It is usually prepared by boiling the leaves and flowers in water to which fresh butter has been added. The decoction is evaporated to the thickness of syrup, and is then strained through a cloth; the butter, in the process, becoming impregnated with the resinous principle of the plant. In this form it retains its activity for years, becoming only slightly rancid with age. The taste is not pleasant, and it is consequently taken mixed with spices and other aromatic substances, in the form of a confection or electuary.

All preparations of Indian hemp are capable of producing intoxication, the most prominent effect of a large dose being pleasant delirium followed by more or less exhaustion. In the case of Orientals, the effect is usually of an agreeable or cheerful character. In India it is known as "the increaser of pleasure"; "the cementer of friendship"; "the cause of a reeling gait"; "the laughter-mover"; and by other terms indicative of its peculiar, physiological action. When administered in full doses, it induces a feeling of exhilaration, attended by certain nervous and mental phenomena which vary with the temperament and idiosyncrasies of the subject, and, possibly, to some extent, with the circumstances by which he is surrounded. The sensations which it produces are, as a rule, pleasurable; beautiful visions float before the eyes, and there is a sense of ecstasy, "which fills the whole being with laughter." The drug is credited with a power of producing true happiness—an enjoyment purely moral and ethereal. The haschish-eater is happy, not like the gourmand who has satisfied his appetite, but "like one who has received the tidings of great joy."

A good idea of the general effects of the drug may be gathered from a perusal of Bayard Taylor's description, in his "Pictures of Palestine," of the sensations he experienced from taking a dose experimentally. * * *

An equally graphic account of the effects produced by the drug is given by Dr. H. C. Wood, of Philadelphia, who some years ago made observations with the American hemp, *Cannabis Americana*. * * *

Sometimes the most ludicrous ideas are produced by the use of Indian hemp. One experimenter, while under the influence of the drug, thought that he was a steam-engine, and suddenly springing from his seat, exclaimed, with a shriek of laughter, "Oh, ye gods! I'm a locomotive!" So thoroughly was he impressed with the idea, that, on raising a pitcher of water to his lips, he put it down again without quenching his thirst, saying, "How can I fill my boiler when I'm blowing off steam?" The sense of prolongation of time is very characteristic, evidently due to the immense rapidity of the succession of ideas. The mind measures time by the duration of its own processes, and when an infinitude of ideas arise before it, in the time usually occupied by a few, time becomes infinitely prolonged to the mind. It is a lifetime in a minute. A common mental condition is the production of double consciousness, a sense of having two existences, of being at the same time one's self and somebody else.

Among the early symptoms may be mentioned a sensation of heaviness in the arms and legs. The head feels hot and heavy, the eyes are bright and shiny, and there may be giddiness, with noises in the ears. The general sensibility is also affected, and pricking in the feet or all over the body, with numbness of a pleasurable kind, may be excited. Pressure on the skin not uncommonly excites a sensation of burning. After a time there is anæsthesia, which may be so complete that the patient, when standing, has no consciousness of touching the ground. Sometimes a cataleptic condition is excited.

Whatever may be the symptoms of the first stage, sooner or later, if the dose be sufficiently large, drowsiness comes on, accompanied by very pronounced anæsthesia and loss of power, especially in the lower extremities. The pupils are dilated, the pulse is quickened, and the patient sleeps heavily, awaking, after a time, hungry and without any of the sense of malaise and discomfort which so often follows a dose of opium. There is no constipating effect on the bowels, and the secretion of urine seems to be increased rather than diminished.

Cannabis Indica never induces dangerous symptoms, and I do not think there is a single case of poisoning on record. I was once asked to see in consultation a case of supposed acute mania, and found that the symptoms were due entirely to some pills containing extract of Cannabis Indica, prescribed for the relief of headache.

Its action on the pulse is uncertain; it is usually quickened, and then slowed, and the same occurs with respiration. The temperature rises or falls according as the drug produces muscular movement or sleep. An aphrodisiac action is often very marked.

Effects on the lower animals are of comparatively little importance. In the case of dogs, there is a stage of exaltation followed by profound sleep. In frogs, there is a period of heightened sensibility, followed by one of lessened reflex action, and the functions of the sensory nerves are lessened.

THERAPEUTICS.—Cannabis Indica is an excellent remedy for megrim or sick-headache, and it is somewhat surprising that it is not more frequently employed. The extract may be given in doses of from one-third to half a grain, in the form of a pill. When the patient suffers constantly from headache, or is liable to an attack on the slightest provocation, a pill may be taken three times a day, for many weeks at a time, without the slightest fear of the production of any untoward effect. Should the patient not speedily obtain relief, care must be taken to ascertain that the extract employed is physiologically active. Excellent results are often obtained in these cases from the administration of pills containing four grains of tannate of cannabin, one being given three times a day, after meals. In some cases the tannate of cannabin is combined advantageously with a couple of grains of valerianate of zinc.

Cannabis Indica is useful in many forms of neuralgia, and in these cases is often given with a thirty-second of a grain of arsenous acid. In cases of painful menstruation the extract often proves very successful. Many asthmatics use it with advantage, but I know of no definite rules for its employment in these cases.

[PREPARATIONS.—Extractum Cannabis Indicæ; Extractum Cannabis Indicæ Fluidum; Tinctura Cannabis Indicæ, 1 Gm. in 5.0 Cc.]

DIGITALIS

Digitalis consists of the leaves of *Digitalis purpurea* or purple foxglove, collected from plants [of the second year's growth]. It grows wild in almost every county in England, and is a favorite garden-plant. The word digitalis is derived from *digitalinum* = a thimble, and foxglove is supposed to be a corruption of "foxes' glew" or foxes' music, and to have reference to an old Anglo-Saxon musical instrument, consisting of bells arranged on an arched support.

The drug was not employed in medicine until about the time of the Norman conquest. For many years it was used empirically; but its real introduction, as a scientific remedy, is due to Dr. William Withering, Physician to the General Hospital in Birmingham. It is a hundred and ten years since he published his well-known "Account of the Foxglove and some of its Medical Uses." He had worked at the subject for ten years before he felt justified in giving to the world the fruits of his experience. It appears, from the preface to his monograph, that, in 1775, he was requested to give an opinion on the value of a family recipe for the cure of dropsy. Its composition was known only to an old Shropshire woman, who often accomplished cures when orthodox practitioners failed to afford relief. The effects produced were said to be violent purging and vomiting, its diuretic action having been overlooked. This secret remedy was composed of no less than twenty different ingredients, and a little investigation served to demonstrate the fact that the only one possessing active properties was powdered foxglove-leaves.

Dr. Withering's interest in the subject was stimulated by hearing that Dr. Cawley, the Principal of Brasenose College, Oxford, had been cured of a pleuritic effusion by the administration of an infusion of the root of this drug, after some of the first physicians of the age had declared that they could do no more for him. He learned, too, that a person in the neighborhood of Warwick had a famous recipe for dropsy, the active ingredient of which was supposed to be digitalis, and that in some parts of Yorkshire foxglove-tea was highly esteemed for this purpose. He at once commenced making observations on his patients, and at his suggestion it was tried in the Royal Infirmary, Edinburgh, by Dr. Hope and Dr. Hamilton. The results seem to have been satisfactory, for in February, 1779, Dr. Stokes made a communication on the subject to the Medical Society of Edinburgh.

Dr. Withering's observations excited considerable opposition, but he consoled himself with the reflection that, "after all, in spite of opinion, prejudice, or error, time will fix the real value upon this discovery and determine whether I have imposed upon myself and others, or contributed to the benefit of science or mankind." The hundred and odd years which have elapsed since these words were written have afforded an ample opportunity of proving the inestimable value of the drug.[1]

ACTIVE PRINCIPLES.—A few years ago it was customary to say that digitalis contained one active principle, the glucoside digitalin. This was formerly official, but was removed from the [British] Pharmacopœia in 1885, because of the difficulty experienced in defining it; there being at least three different substances known under this name:

Homolle's digitalin, a yellowish-white, amorphous powder—sometimes met with in small scales—inodorous, irritating to the nostrils, insoluble in water and in ether, but soluble in alcohol and in acids. It is still largely used in France in the form of the *granules de digitaline.* It is a mixture of digitalin and digitoxin.

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[1] WILLIAM MURRELL: "The Centenary of Digitalis." Lancet, August 22d, 1885.

Nativelle's digitalin or crystallized digitalin, occurring in the form of white, crystalline tufts of needles, light, very bitter in taste, and insoluble in water and in ether. It consists almost entirely of digitoxin.

Soluble or *German digitalin,* composed chiefly of digitaleïn.

The digitalin, formerly of the British Pharmacopœia, was almost insoluble in water, and consisted of digitoxin and digitalin in varying proportions, like Homolle's digitalin.

This classification is now antiquated, and Schmiedeberg finds that digitalis contains at least five principles, in addition, possibly, to products of their decomposition. These principles are not alkaloids, but, with the exception of the first, are glucosides. They are :

Digitoxin, insoluble in water—The chief constituent of Nativelle's digitalin.

Digitalin, insoluble in water—The chief constituent of Homolle's digitalin.

Digitaleïn, soluble in water—The chief constituent of the German digitalin.

Digitonin, and

Digitin.

The first three are heart-poisons. Digitonin is either identical with saponin (the active principle of soap-bark and senega) or is closely allied to it. It splits up, when boiled, into grape-sugar and sapogenin, and forms a soapy emulsion when mixed with boiling water. Digitin is physiologically inactive.

To sum up :

Homolle's digitalin=digitalin and digitoxin ; Nativelle's digitalin=digitoxin ; German digitalin=digitaleïn.

And, conversely :

Digitoxin is the chief constituent of Nativelle's digitalin.
Digitalin is the chief constituent of Homolle's digitalin.
Digitaleïn is the chief constituent of German digitalin.

The action of watery and alcoholic preparations is not identical, arising from the difference in solubility of the various principles of digitalis in water and alcohol, respectively. An infusion contains chiefly digitonin, whilst the tincture contains digitalin and digitaleïn. Neither of them contains much digitoxin, but the tincture contains more than the infusion. The preparation usually employed to act on the heart is the tincture, whilst the freshly-prepared infusion is the best diuretic. Digitalis often fails to give satisfaction clinically, from the wrong preparation being employed.

Action.—It is no easy matter to give a concise account of the action of digitalis, for it is a subject on which there is much difference of opinion. Large doses excite nausea, vomiting, and diarrhœa, the vomited matter having a grass-green color from the action of gastric juice on some of the constituents of the drug. The active principles are not destroyed in the stomach, for the same effects are produced when they are given by the mouth as when injected hypodermically.

The great and characteristic action of digitalis is that it affects elasticity of the cardiac muscle without at first modifying its contractile power. The immediate effect of this alteration is indicated by increase in volume of the pulse, although the absolute working-power of the heart is neither increased nor decreased. At the same time, the quantity of blood driven into the aorta is greater than before, not only at every beat of the pulse, but even in a given unit of time, notwithstanding the number of pulsations may be diminished. The result is a better filling of the arteries and an increase in blood-pressure. Accompanying this condition there is a slowing of the pulse, due to stimulation of the inhibitory mechanism of the heart.

Finally, in conjunction with continuous high-pressure, we get irregularity both in the action of the heart and in the frequency of the pulse. Digitalis does not exert a sedative action on the muscular substance of the heart. Although that organ may be beating more slowly, it may also be doing more work.

Action of the drug on the heart is best studied on the frog. The first distinctive action is a marked lessening in the rate of the cardiac beats, due to prolongation of the diastole. The systole is abnormally energetic, so that the ventricles become white as the last drop of blood is squeezed out of them. The rhythm is much affected, auricles and ventricles no longer beating in accord. The heart is irregular in its contraction, one part being hard and white from strong contraction, whilst another is dilated. Finally, the heart is arrested in systole, and dies in this condition.

The contracted, irregular heart is characteristic of digitalis and its congeners. This condition is noticed after division of the vagi, and even after destruction of the spinal cord. It is evident that digitalis acts directly on the heart-muscle itself. There is, however, reason to think that the inhibitory activity of the peripheral ends of the pneumogastrics is increased. There is no stage in which stimulation of the vagi will not produce diastole. It is said that a current applied to the vagi, which will not arrest the heart in diastole, will do so after the administration of digitalis.

In man, its effect on the pulse is peculiar. At first the pulse is slowed, then it is made quicker, then it becomes irregular, and finally, when the dose is sufficiently large, it is arrested. There is an increased rise in blood-pressure. This might be due to an increase in the power of the contraction of the heart, or to contraction of the arterioles, or to both combined. Schmiedeberg and Boehm both hold that the rise in blood-pressure is due entirely to an increased action of the heart, and not at all to contraction of the vessels. Brunton, on the other hand, thinks that it is due, in great measure, to contraction of the arterioles. The mitral [initial?] slowing of the pulse is due to stimulation of the vagus-roots of the medulla, and partly to stimulation of the ends of the nerve of the heart. The subsequent rapidity of the pulse is the result of paralysis of the vagus ends. The irregularity is due to the action of the drug on the heart itself.

Wood sums up the action of digitalis by saying that, in moderate doses, it stimulates the muscular-motor portion of the heart—probably of its ganglia—increases activity of the inhibitory apparatus, and produces contraction of the arterioles.

Digitalis acts as a powerful diuretic, especially in cases of cardiac disease. This is the result of increased blood-pressure, and if the latter is already at its normal height no increase in the excretion of urine is produced. Most observers state that it has no such power in health, but Brunton, experimenting on himself, found that although small doses had little or no action, marked diuresis followed when the drug was pushed so as to produce symptoms of poisoning. To obtain its action on the kidneys it is necessary, for reasons already explained, to employ a freshly-prepared infusion.

Digitalis lowers the temperature of febrile patients, and toxic doses lower the temperature several degrees, both in healthy men and in animals. The influence of moderate doses on the normal temperature is uncertain.

It is said to be an aphrodisiac, both in men and women, but this is doubtful. In France it is employed as an abortifacient.

Digitalis exerts what is called a cumulative action. When blood-pressure is at its height the secretion of urine is arrested, and it is to this power of arresting the eliminative function of the kidneys that the cumulative action of the drug is due.

THERAPEUTICS.—Digitalis is allied in action to strophanthus, squill, convallaria, apocynum, adonis, and a number of other drugs. Barium, in its action on the heart, is allied to digitalis.

The action of digitalis on the heart is antagonized by the belladonna-group and by aconite.

It is generally said that digitalis does harm in aortic regurgitation, and that it does good in obstructive mitral disease ; but it is better to rely on symptoms, rather than on the nature of the valvular lesions, as indications for administrations of the drug. A rough-and-ready rule, which works well in practice, is that digitalis can be given when the pulse is irregular or intermittent and the urine is scanty. Another point to remember is that, as a diuretic, the freshly-prepared infusion is a better preparation than the tincture.

Digitalis is a useful diuretic, especially in Bright's disease, and the following pill, given at bedtime, will increase the secretion of urine when it is scanty :

Powdered Digitalis,	
Squill,	
Blue-pill,	āā gr. j.
Extract of Hyoscyamus,	gr. ij.

Some years ago Wunderlich and other German observers advocated the administration of large doses of digitalis in acute specific diseases. He gave from half a drachm to a drachm of the powdered leaves, the dose being spread over four or five days. Hirtz gave half a drachm a day, and Hankel occasionally as much as one hundred grains daily. I have recorded a case of typhoid fever which suddenly terminated fatally during its treatment by digitalis. The patient was a child ten years of age, and the dose given was nine minims of the tincture—equivalent to a little over a grain of the leaves—every two hours. Eight days later the dose was increased to twelve minims every two hours, and, after taking six doses, the patient died, the pupils immediately before death being widely dilated, and the radial pulse being so weak that it could hardly be felt. It was the twentieth day of the disease, and the temperature, on the evening preceding the fatal termination, was 104.8° F. Digitalis undoubtedly lowers the temperature, but other drugs are employed for this purpose with less risk.

The late Mr. Jones, of Jersey, in cases of delirium tremens, gave half-ounce doses of the tincture of digitalis, repeating it in four hours, and subsequently continuing the medicine, if necessary, in two-drachm doses. Seventy cases were treated by him in this manner without the production of any alarming symptoms; but other observers were not so fortunate, and in two cases the patient fell back dead, although, up to the moment of death, there had been nothing to indicate serious danger.

It is decidedly unwise to employ such large doses of digitalis, although, on the other hand, there is often an exaggerated fear of the dangers attending use of the drug in moderate doses. It must be remembered that if a patient dies suddenly when taking digitalis, the death is always attributed to the treatment; whereas if any other drug were given, the result would probably be attributed to the disease.

[PREPARATIONS.—Extractum Digitalis; Extractum Digitalis Fluidum; Infusum Digitalis, 15 Gm. of leaves to each 1,000 Cc.; Tinctura Digitalis, 1 Gm. in 6.67 Cc.]

STROPHANTHUS

[According to the U. S. Pharm., strophanthus is the seed of *Strophanthus hispidus* De Candole (nat. ord. *Apocynaceæ*), deprived of its long awn.] Its native name is *kombé*, and it comes from Zambesi and other parts of Africa.

The ACTIVE PRINCIPLE of strophanthus—strophanthin [a glucoside]—is most abundantly present in the seeds, where it occurs along with substances of little pharmacological interest, such as albumen, mucilage, resin, extractive matters, etc. Strophanthin is a very powerful pharmacological agent. As regards frogs, it has three times the activity of aconitine, and is ten times as active as pseudaconitine. With mammals, however, it is less lethal than either of those alkaloids.

ACTION.—For our knowledge of the pharmacological action of this drug, we are indebted almost exclusively to Professor T. R. Fraser, of Edinburgh, whose papers on the subject will always remain models for work devoted to the action of drugs.

Strophanthus is a member of the digitalis-group, and is essentially a muscle-poison. Its action on skeletal muscles is very marked. Under its influence the muscles become enfeebled; somewhat rigid; affected with fibrillary twitchings, and, finally, non-contractile, pale, and hard. Their reaction is changed from the normal alkaline to acid, and lactic acid can be separated in considerable quantities. Strophanthus paralyzes the muscles chiefly by diminishing their power to relax, and it then rapidly destroys this capability by producing a condition indistinguishable from that of *rigor mortis.*

The spontaneous, fibrillary twitchings of the muscles, to which reference has been made, are non-rhythmical, increasing contractions, which may be likened to the muscular contractions of graver forms of chorea. The strophanthus chorea involves, in succession, independent fasciculi of many single muscles, in contrast to the involvement of entire muscles which occurs in true chorea. They are the result of the action of the drug on the terminations of motor nerves in the muscles.

Strophanthus acts directly on the cardiac muscle, one of the chief results of this action being an increase of contractility, rendering the systole more prolonged and more perfect. After a large dose, the systolic type of change is well-marked, and the capability of relaxing is so diminished that diastole becomes impossible; the heart ceasing to beat with the ventricle so thoroughly contracted that its cavity is almost effaced. The muscle is so profoundly affected that it passes at once into a state of *rigor mortis.*

When only small doses of strophanthus are given, the heart assumes the diastolic type, and the irritability and contractility of the heart are not destroyed. Even when the heart has been brought to a standstill in a state of diastole, mechanical irritation invariably causes perfect contraction; whilst rhythmical contractions now and then occur spontaneously. Actual loss of contractility occurs only when the largely-dilated ventricle, after a long period of suspended action, gradually loses its abnormal dilatation, by slowly, and almost imperceptibly, shrinking to normal or subnormal dimensions. Experiments with atropine *plus* strophanthus show that stimulation of the cardio-inhibitory apparatus is not the cause of the diastolic condition. It is improbable that it is the result of a direct action on the muscle of the heart, for, even in the extreme forms of the diastolic type, the contractions are strong, and suffice to completely empty the ventricle. It is much more probable that weakness of the excito-motor nerve-structures is the chief cause, and that this action operates simultaneously with the action on the muscle which increases its contractility. The following points have been demonstrated:

A systolic type of change is produced by large doses, and a diastolic, by small doses.

Whatever may be the type, great increase occurs in the movements of the heart by exaggeration of expansion as well as of contraction.

Slowing of the rate of contraction is always produced.

Auricular expansions and contractions are increased as well as the ventricular, and most obviously so when the type is diastolic.

The production of this increase in movements of the heart—consisting of a greater amplitude of diastolic expansion, and a more complete systolic contraction—is significantly emphasized when the action of the drug is produced in an enfeebled and insufficiently-acting heart.

In the systolic type of action, the heart-muscle rapidly acquires an acid reaction, showing that the drug acts on the heart in the same way that it acts on the skeletal muscles.

In the diastolic type, the heart-muscle is neutral or alkaline, even for a considerable time after paralysis of the heart has been induced.

The action of strophanthus on the heart is more powerful than that of any other known drug.[1]

Strophanthus exerts little or no action on the blood-vessels, and no action on the brain.

When applied to the eyes, a solution of strophanthin produces only slight and transitory blunting of sensibility. This incomplete anæsthesia is accompanied by disagreeable irritation of the eye, especially at the inner canthus, and by a bitter taste in the mouth. No effect is produced on vision-accommodation or on intraocular pressure.

Neither in frogs nor in rabbits has any distinct effect on secretion been observed after single lethal or non-lethal doses, excepting that occasionally, in frogs, there is an increase of secretion by the skin.

It is claimed for strophanthus that it is less apt than digitalis to produce cumulative effects, and that it acts with greater certainty and rapidity. The great advantages of strophanthus are :

It contains an active principle of far greater potency than any that can be extracted from digitalis.

It has little or no action on the blood-vessels.

It produces no gastric disturbance.

It is extremely rapid in its action.

The disadvantages of strophanthus are : That it is often adulterated with allied but inferior species, and that the tincture, as supplied commercially, is variable in strength and quality.

[Preparation.—Tinctura Strophanthi, 20 per cent.]

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[1] In support of the last statement, it may be mentioned that strophanthus is three hundred times as powerful as Merck's digitalin, and thirty times as powerful as convallamarin.

PURGATIVES

Castor-oil—Croton-oil—Aloes—Cascara Sagrada—Colocynth—Elaterium—Jalap—Podophyllin—Rhubarb—Senna

These drugs all belong to the class of purgatives, cathartics, or aperients—drugs which are employed to produce purgation or catharsis by increasing either intestinal secretion or peristaltic movements, or which may be defined, briefly, as substances which cause intestinal evacuation.

Purgatives derived from the vegetable kingdom correspond to cutaneous irritants in the nature of their action; the latter produce irritation of the skin, and the former stimulate or irritate the intestines, and give rise to increased secretion, and to peristaltic movements which expel the contents of the bowel and allow no time for reabsorption of the fluid which may have been poured out into the intestines.

Some purgatives act on the motor ganglia of the intestines, and act equally well whether given hypodermically or otherwise; such being the case with aloïn, rhubarb, and senna. An infusion of the latter, injected into the blood, induces prompt catharsis.

Almost any irritant, not possessing toxic properties, might, theoretically, be employed as a purgative; but volatile drugs, and drugs which are readily absorbed from the stomach, pass into the general circulation at once, and fail to reach the intestines, so that they are unsuited for this purpose.

Many substances, such as castor-oil, croton-oil, and jalap, pass through the stomach unchanged, and are not acted on until they come in contact with the alkalies of the bile and pancreatic juice, and then become efficient as purgatives.

Purgatives may be classified as follows:

Laxatives, the mildest purgatives, do little more than increase peristaltic movements and soften the fæces. To this class belong figs, prunes, honey, treacle, manna, tamarinds, sulphur, magnesia, and castor-oil (in small doses).

Simple Purgatives.—These are somewhat stronger than laxatives, and their administration is usually followed by one or more copious evacuations, although there is no great increase of intestinal secretion. Examples of this group are castor-oil (large doses), aloes, rhubarb, cascara sagrada, and senna.

Saline Purgatives.—The properties of this group have already been considered in detail. The best examples are the sulphates of potassium, sodium, and magnesium; phosphate of sodium, and tartrate of potassium. Most of the natural purgative-waters depend for their properties on the presence of these salts in various proportions.

Hydragogues.—These are purgatives which excite a copious secretion from the intestinal mucous membrane. The best examples are elaterium, gamboge, and cream of tartar.

Drastics.—These give rise to violent action of the intestines, often accompanied by pain and griping. They increase both the intestinal secretion and the peristaltic action. They are closely allied to the hydragogue purgatives, but stimulate peristaltic action more than intestinal secretion. Examples are: elaterium, jalap, scammony, colocynth, croton-oil, and podophyllin.

Cholagogues.—These act on the liver and, probably, on the pancreas as well as on the intestinal tract. Some act simply as hepatic stimulants, but other members of this group, by their action on the intestines, assist in expelling the bile and preventing its reabsorption. Examples are: gray-powder, blue-pill, calomel, aloes, podophyllin, and, perhaps also, euonymin and iridin.

A strictly accurate pharmacological classification of purgative agents is difficult, as the active principles of many of those which are of vegetable origin have not, as yet, been isolated.

CASTOR-OIL

Castor-oil, or Oleum Ricini, is expressed from the seeds of *Ricinus communis*, the castor-oil plant or Palma Christi. The plant is common in many tropical climates, and in Spain attains a height of from fifteen to twenty feet, with a trunk as big as a man's body. In England, it is cultivated as an ornamental plant, and is often used to keep flies away from rooms. The seeds are the size of a small bean, oval, compressed, obtuse at the ends, smooth and polished on the surface, of a light ash-color, and marbled with black spots and veins. The oil is thick, viscid, colorless or of a pale straw-color, and should be nearly tasteless. The best oil is the "cold-drawn" or that which is expressed without heat. Castor oil is a good example of a "fixed" as contrasted with a "volatile" oil. It is said to be often adulterated with some cheap, bland oil; a drop or two of croton-oil being added to make it active. The seeds contain an acid, drastic principle; an alkaloid called ricinine (which is not physiologically active), and several fatty acids, including ricinoleic acid, which is peculiar to castor-oil.

Action.—Castor-oil is a mild but decided purgative, producing copious, fluid fæcal discharges. Its action on the liver is slight, and, if anything, the secretion of bile is diminished as soon as the purgative stage is fully established. When rubbed into the skin, it is absorbed, and produces its characteristic action. Injected into a vein, it induces malaise, nausea, fainting, anxiety, and general dulness and depression without purging. It is probable that it is eliminated with the fæces, but this is uncertain.

It has been stated that castor-oil is a galactagogue; but pilocarpine is the only drug which has the power of increasing the secretion of milk in nursing women.

CROTON-OIL

Croton-oil, or Oleum Tiglii, is expressed from the seeds of *Croton Tiglium*, growing in the East Indies. The seeds resemble those of castor-oil, but are smaller, duller and browner in color, and are not mottled. The oil is slightly viscid, pale-yellow in color, and acrid to the taste. Its composition is complex, and its active principles have not yet been separated.

Crotonol is an oily substance, said to possess the irritant properties of croton-oil. It is more probable, however, that the oil owes its vesicating properties to croton resin—a hard, pale-yellow, brittle substance, nearly insoluble in water, but freely soluble in alcohol, ether, and chloroform. There is reason to suppose that it is either a lactone or an anhydride of complex structure.

ACTION.—Applied locally, croton-oil irritates the skin, and produces redness, vesication, and pustulation, not infrequently followed by permanent scarring. The irritant action is much increased by the addition of an alkali, such as liquor potassæ. Croton-oil may excite an erythema, even when taken internally. It is a good example of a drug which acts as an irritant to the skin and is, at the same time, a powerful purgative.

Croton-oil is a violent, drastic, and hydragogue cathartic. The fact that a drop placed at the back of the tongue speedily evacuates the bowels, renders it especially suitable in cases of insensibility from apoplexy and other causes, when difficulty is experienced in inducing the patient to swallow other drugs. It exerts very little action on the secretion of bile. In large doses, it is a violent, irritant poison. Most of the cases of poisoning by castor-oil are due to the fraudulent admixture of a small quantity of croton-oil to increase the purgative effect.

ALOES

There are two official kinds of aloes—Barbadoes aloes, obtained from *Aloë vulgaris,* and Socotrine aloes from *Aloë socotrina* and other species. The drug is procured by making transverse incisions into the bases of the leaves. The medicinal effects vary but little, but Barbadoes aloes is slightly more active.

Aloes enters into the composition of a great number of preparations; indeed, there are few laxative pills which do not contain it. The compound decoction of aloes is popularly known as *Baume de Vie.* The pill of aloes and myrrh contains saffron, and is called Rufus' pill, from its red color.

Aloïn, the most important constituent of aloes, is a neutral, bitter principle, very sparingly soluble in cold water, but dissolving readily in hot water and in diluted alcohol. Were it not for its insolubility in cold water, aloïn would be largely employed hypodermically as a laxative. There are three varieties of aloïn—barbaloïn, socaloïn, and nataloïn, obtained, respectively, from the Barbadoes, Socotrine, and Cape aloes. Squibb says that the various kinds of aloes differ as much from each other as do the alkaloids of cinchona bark; but this view is not generally held, and they are probably pretty much alike in their action. The aloïn of commerce is usually in tufts of bright-yellow, acicular crystals.

Aloes also contains a resinoid body, which differs from ordinary resins in being soluble in boiling water. *Aloëtic acid* and a *volatile oil* are also mentioned.

ACTION.—In the lower animals, hypodermic injections of aloïn give rise to a peculiar form of inflammation of the kidneys: The tubules lose their epithelium, but while the glomeruli remain intact, they become surrounded by an increase of fibrous tissue. The aloïn can be detected in urine, which, then, often contains albumin.

THERAPEUTICS.—Most observers state that aloes exerts a laxative action, by whatever means it is introduced into the system, and maintain that it acts equally well whether taken by mouth, rubbed into the skin, or injected hypodermically. Others are of opinion that it fails to exert any action unless brought into contact with the bile; and, in support of this view, point out that an enema of aloes exerts no more action than an enema of water, unless previously mixed with ox-bile, when it acts as a powerful irritant. As throwing some light on the subject, it may be pointed out that a hypodermic injection of aloïn acts as a laxative, and that powdered aloes, sprinkled on a blistered surface, is an efficient purgative. It is generally admitted, too, that when aloes is administered to a nursing woman it purges the child at the breast. Some authorities are of opinion that the specific action of aloes is exerted solely on the colon and rectum, and that it is a simple evacuant of fæces; while, by others, it is held that its primary action is to increase the secretion of bile, and that the purgative or laxative action is secondary. It is said that aloes is useless in cases of jaundice when there is no bile in the intestines, but it is found, experimentally, that large doses of aloes powerfully stimulate the liver of a dog.

Aloes is a tardy laxative, and it may be six, twelve, or twenty-four hours before it operates. It is useless when prompt action is required. The motions produced by aloes are bulky, a little softened, and not watery. It differs from other purgatives in not producing subsequent constipation. Its habitual use, in large doses, is said to cause tenesmus; a feeling of weight, heat, and uneasiness in the pelvis; and a tendency to the production of piles; but of this there is no proof. It is said, too, that it induces hyperæmia of the uterus, increases the menstrual flow, and produces sexual excitement.

Aloes is often employed as a "dinner-pill," a formula for which is:

Extract of Barbadoes Aloes,	gr. ij.
Extract of Nux-vomica,	gr. ss.
Extract of Gentian,	gr. jss.

These pills are to be taken once or twice a day, half an hour before meals. They are largely resorted to by elderly people who live well and take but little exercise. They may be taken for years without losing their effect.

An old-fashioned dinner-pill, known as "Lady Webster's," contains:

Powdered Socotrine Aloes,	gr. ij.
Powdered Mastic,	gr. ss.
Powdered Red-rose Leaves,	gr. ss.

"Lady Hesketh's" and "Lady Crespigny's" pills have a similar composition. The formula is a very old one, and may be found in the Paris Codex of 1758 [and Redwood's "Supplement to the Pharmacopœia"].

For habitual constipation with anæmia, aloes is often given in combination with iron, a favorite formula being:

Sulphate of Iron,	gr. ij.
Extract of Aloes,	gr. j.

These pills are given at first three times a day, then twice a day, and, finally, only once a day. They are efficacious, but it may take a fortnight to produce the desired effect. The addition of the iron is a distinct improvement on the simple aloes pill.

Aloes is the active ingredient in most of the widely-advertised patent medicines.

"Holloway's pills" consist of aloes, 62 grains; rhubarb, 27 grains; Glauber's salt, 3 grains; pepper, 7 grains; and saffron, 3 grains.

The Sequah's "Prairie Flower" contains, in two ounces: Aloes, 105 grains; carbonate of sodium, 35 grains; water, 735 grains, with a few drops of tincture of capsicum and tincture of myrrh.

"Mother Seigel's Syrup" contains two drachms of aloes in four ounces, with a little treacle, borax, capsicum, and liquorice.

CASCARA SAGRADA

Cascara sagrada—the sacred bark—is the dried bark of *Rhamnus Purshiana*. The drug contains several resinous bodies, derivatives of chrysophanic acid, and is also rich in tannin. It is allied in action to *Rhamnus catharticus* (the old-fashioned buckthorn), and to *Rhamnus frangula* (black alder). It is less drastic than the former, and more active than the latter.

THERAPEUTICS.—Cascara sagrada is usually described as a "tonic laxative," but I would rather take my tonics and laxatives separately. My experience of one of the most popular fluid-extracts of cascara sagrada is, that if you take forty minims in water, at bedtime, it disturbs you before you have finished dressing in the morning; and if you take it in the morning, it disturbs you at breakfast just as you are reading your paper. It is true that it does not gripe, and that it produces no straining; but it does not evacuate the contents of the intestines thoroughly, and it seems to me to be less satisfactory in its action than a small dose of calomel given in a pill with extract of hyoscyamus. It may be given advantageously with other laxatives. The following is a useful formula:[1]

Extract of Cascara Sagrada,	gr. ij.
Aloïn,	gr. $\frac{1}{5}$
Strychnine,	gr. $\frac{1}{16}$
Extract of Belladonna,	gr. $\frac{1}{8}$
Ipecacuanha,	gr. $\frac{1}{16}$

This pill—coated or varnished by preference—is to be taken in the morning before breakfast, or three times a day after meals, according to the necessities of the patient.

Buckthorn-juice and buckthorn-berries are now rarely used. An old writer says: "They be not meete to be ministered but to young and lustie people of the countrie, which doe set more store of their money than their lives."

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[1] MURRELL: Practitioner, vol. xxxix, p. 417.

COLOCYNTH

Colocynth is the pulp or pith of *Citrullus Colocynthis*, which grows on the shores of the Mediterranean, and also in India. It is the bitter apple or bitter cucumber, and the "wild vine" (literally the vine of the field) of the Old Testament. It was formerly imported from Mogadore, unpeeled, but now comes to us from Smyrna, Trieste, France, and Spain, already deprived of its outer covering. The pulp alone is employed, the pips being rejected because they are inert. In some parts of Northern Africa these seeds constitute an important article of diet amongst the natives.

Active Principle.—Its active principle is the glucoside colocynthin. The pulp contains, in addition, a good deal of resinous matter.

Action.—Colocynth is a powerful, drastic, cholagogue purgative, and is commonly given in combination with aromatics and other substances, to moderate the violence of its action and prevent griping. It produces copious, watery motions, which, after large doses, may be serous, mucous, or mixed with blood. It promotes peristaltic action, and often gripes severely. It stimulates the intestinal glands, and increases the secretion of bile. In large doses it may produce gastro-enteritis.

The tincture of colocynth, of the German Pharmacopœia, purges if rubbed into the skin of the abdomen.

Colocynthin acts equally well as a purgative, whether taken by the mouth, injected hypodermically, or introduced directly into the circulation.

Colocynth is also a diuretic, and, when administered to dogs, produces inflammation of the kidneys and bladder. It is fatal to many of the lower forms of animal life, and is frequently used for the destruction of moth.

When the powdered pulp is inhaled, it induces sneezing, and irritates the nostrils. Those who are engaged in handling the drug often suffer from violent purging.

Colocynth is allied to aloes, but differs from it in its drastic action; in acting on the whole of the intestinal tract, and not solely on the lower bowel, and in the absence of tonic properties.

THERAPEUTICS.—When colocynth is administered for its purgative action, it is commonly given in combination with other purgatives. The following is a favorite formula for an aperient pill:

Compound Colocynth-pill,	gr. ij.
Blue-pill,	gr. ss.
Extract of Hyoscyamus,	gr. j.
Powdered Ipecacuanha,	gr. ⅛.

ELATERIUM

Elaterium is the sediment of the fruit of the squirting cucumber, *Ecballium Elaterium*. The fruit is cut, and the juice is gently pressed out, passed through a hair sieve, and set aside to deposit. The supernatant fluid is poured off, and the sediment is dried on porous tiles in a warm place.

THE ACTIVE PRINCIPLE of elaterium is elaterin. This is not an alkaloid, but a chemically neutral substance. Much of the elaterium of commerce is impure. The best contains twenty-five to thirty-three per cent. of elaterin; the worst, not more than fifteen per cent.

ACTION.—Elaterium and elaterin are powerful, drastic, hydragogue purgatives. They increase peristaltic action and intestinal secretions. They induce purgation only when taken internally, and only when brought in contact with the bile.

Injected subcutaneously, they cause salivation, insensibility, tetanus, and dyspnœa.

Large doses, taken internally, excite inflammation of the stomach, intestines, and peritoneum.

Applied locally, elaterium acts as an irritant to the skin, and people engaged in handling the drug, and preparing it for market, suffer from ulceration of the fingers.

The dose of good elaterium is from one-eighth to one-quarter of a grain, and of elaterin, from one-sixteenth to one-twelfth of a grain.

JALAP

Jalap, the tuberous root of *Ipomœa jalapa,* also known as *Exogonium purga,* is imported from Mexico, the drug having been named after the city of Xalapa. Jalap resin is obtained by the action of diluted alcohol, and contains convolvulin.

ACTION.—Jalap is a hydragogue purgative, but purges only when brought in contact with the bile. It increases both the solid and the watery constituents of bile, and stimulates the intestinal glands. It may be described as being a powerful intestinal stimulant, and a moderately-powerful hepatic stimulant. It exerts no action when injected hypodermically, or directly into a vein. It is not an irritant when applied to the skin or to the mucous membranes, and it is not a diuretic.

In general action, it is allied to scammony.

PODOPHYLLIN

Podophyllin, or resin of podophyllum, is obtained from *Podophyllum peltatum,* the American Mayapple or mandrake. The plant grows wild in North America, whence it is imported in large quantities. The rhizome was originally employed as a purgative (so it is said) by North American Indians. In 1820, it was introduced into the United States Pharmacopœia, and thirty-four years later it found a place in the British Pharmacopœia. The resin, podophyllin, is a popular purgative and has a large sale. It is sometimes called "vegetable calomel," or "vegetable mercury," and most of the patented purgative-pills, "warranted free from mercury," contain it as one of their chief ingredients.

ACTIVE PRINCIPLES.—Podophyllin contains two active substances, podophyllotoxin and picro-podophyllin, besides fatty and resinous acids.

ACTION.—Podophyllin increases the intestinal secretions, and produces copious and rather watery motions. As a purgative, it is not only tardy, but is somewhat uncertain in its action. It often gives rise to nausea and griping. Rutherford and Vignal have shown that it has a marked action in increasing secretion by the liver. It acts on the bowels when injected subcutaneously. Injections of podophyllin into the peritoneum of the lower animals, give rise to vomiting, profuse purging, with blood in the motions, and finally produce death from exhaustion. The drug seems to have a special affinity for the duodenum, and, *post-mortem*, this part of the intestine is found to be inflamed, or even ulcerated.

RHUBARB

Rhubarb is the root, more or less denuded of its bark, of *Rheum palmatum*, *Rheum officinale*, and other species. It is collected and prepared in China and Thibet. The pieces are usually pierced with a hole. This is not caused by the ravages of insects, as is sometimes stated, but is the hole through which the string passes when the pieces are hung up to dry.

ACTIVE PRINCIPLES.—*Chrysophanic Acid;* met with in the form of brilliant, yellow crystals. It is also found in chrysarobin, the araroba- or Goa-powder, a substance largely employed in the treatment of psoriasis and other skin diseases.

Chrosophan, a glucoside which readily splits up into chrysophanic acid and sugar.

Phæoretin, a resinous body, which is actively purgative.

Rheo-tannin, a peculiar form of tannic acid.

Oxalate of Lime and other mineral salts.

ACTION.—Dr. C. D. F. Phillips points out that rhubarb affords a striking example of the general, though not universal law, that changes in dosage alter the degree in which a medicament acts upon the body, and, when carried beyond a certain point, modify its type of action. In small doses, rhubarb exerts no purgative action, but acts as a tonic to the digestive functions, increasing the appetite and the powers of assimilation. In large doses, it induces none of these tonic effects, but acts as a laxative; the stools being of a loose but not watery consistence, and usually of a yellowish-brown color. When the laxative action is well marked, it is usually followed by a certain amount of constipation; the rheo-tannic acid at this stage exerting its influence.

It is probable that rhubarb affects, especially, the mucous secretions of the duodenum, and increases the peristaltic action of that particular portion of the intestine. In dogs, it acts as a certain, though by no means powerful, hepatic stimulant.

It imparts a yellow color to the milk of nursing women, and also to urine. Rhubarb-urine is distinguished from the urine of jaundice by becoming purplish-red on the addition of an alkali.

SENNA

There are two official kinds of senna—the Alexandrian, and the East Indian or Tinnivelly. The former consists of the leaflets of *Cassia acutifolia;* the latter, of the leaflets of *Cassia angustifolia.* Either kind of senna may be employed for making the preparations.

ACTIVE PRINCIPLES.—The chief of these is cathartic acid, a chocolate-brown, amorphous powder, soluble in water, and possessing purgative properties.

ACTION.—Senna acts as a laxative, or brisk purgative, according to the dose administered. Its sphere of action is exerted chiefly on the small intestine, where it stimulates both secretion and peristaltic action. If given alone it sometimes gripes; but it is possible that griping may be due to the admixture of other leaves, which should have been excluded. Injected into the veins, it induces vomiting and purging. It, or its active principle, is eliminated with all the secretions, and the milk of a nursing mother, to whom senna is given, will purge the infant. Senna possesses none of the tonic effects of rhubarb. Compared with aloes, it acts more on the small intestine, while on the lower bowel it exerts less effect. Cathartic acid exerts the mild, purgative action of the drug, and rarely produces nausea, vomiting, or griping. Being soluble in water, it is easily administered when flavored with syrup of wild-cherry. The dose is five grains for an adult.

[PREPARATIONS.—*Socotrine Aloes.*—Aloe Purificata ; Extractum Aloes.

Purified Aloes.—Extractum Colocynthidis Compositum ; Pilulæ Aloes; Pilulæ Aloes et Assafœtidæ ; Pilulæ Aloes et Ferri ; Pilulæ Aloes et Mastiches; Pilulæ Aloes et Myrrhæ ; Pilulæ Rhei Compositæ; Tinctura Aloes; Tinctura Aloes et Myrrhæ; Tinctura Benzoini Composita.

Cascara Sagrada.—Extractum Rhamni Purshianæ Fluidum.

Colocynth.—Extractum Colocynthidis ; Extractum Colocynthidis Compositum ; Pilulæ Catharticæ Compositæ ; Pilulæ Catharticæ Vegetabiles.

Elaterium.—Trituratio Elaterini, 10 per cent.

Jalap.—Extractum Jalapæ ; Pulvis Jalapæ Compositus ; Resinæ Jalapæ. Of the alcoholic extract are prepared : Pilulæ Catharticæ Compositæ ; Pilulæ Catharticæ Vegetabiles.

Podophyllin is termed "Resina Podophylli" in the U. S. Pharm., the only official preparation being : Pilulæ Catharticæ Vegetabiles.

Podophyllum (the drug).—Official preparations are : Extractum Podophylli ; Extractum Podophylli Fluidum; Resina Podophylli.

Rhubarb.—Extractum Rhei Fluidum ; Pilulæ Rhei ; Pilulæ Rhei Compositæ ; Pulvis Rhei Compositus ; Tinctura Rhei ; Tinctura Rhei Aromatica ; Tinctura Rhei Dulcis.

With the fluid-extract is prepared: Mistura Rhei et Sodæ; Syrupus Rhei; and, with the aromatic tincture, Syrupus Rhei Aromaticus.

Senna.—Confectio Sennæ; Extractum Sennæ Fluidum; Infusum Sennæ Compositum; Pulvis Glycyrrhizæ Compositus; Syrupus Sennæ. The fluid-extract is the starting-point in preparing Syrupus Sarsaparillæ Compositus.]

CAMPHOR

Camphor is defined as a stearopten obtained from *Cinnamomum Camphora*, the camphor-tree or camphor-laurel, and is commonly imported in a crude state and purified by sublimation.

The tree producing it is a large evergreen, not unlike the linden, and a native of China and Japan. All parts of the plant evince by their odor the presence of the substance which it secretes. Camphor is also obtained from other plants; in fact, the Borneo camphor, from the trunk of the *Dryobalanopus Camphora*, was the first variety introduced into Europe, but is now rarely met with; being employed, almost exclusively, for embalming the Bata chiefs. It is an expensive article, the best specimens commanding about twenty-five dollars a pound.

Borneo camphor is commonly known as borneol, but the latter term is also applied to Ngai camphor, and to a substance prepared artificially from turpentine.

The process of preparing the ordinary camphor presents some points of interest. In the first place the root, smaller branches, and, perhaps, portions of the stem, are placed with a little water in a large iron vessel; heat is then applied, and the camphor volatilized by the steam is condensed on earthen covers lined with rice straw. This preliminary process varies somewhat in different countries, but the principle is always the same.

Crude camphor is in small grains or granular masses, and is usually dirty and mixed with impurities. It is exported in this state, and is subsequently purified to adapt it for medicinal and general uses. The vessels employed for this purpose are made of cast-iron, are circular in shape, and from twelve to fifteen inches in diameter and four inches deep. The sides are perpendicular, and there is a ledge on the top on which the cover rests. In the centre of the cover is a hole, covered loosely by a small, hollow cone. The crude camphor is mixed with lime, the purpose of which seems to be to absorb the moisture which would interfere with the regular solidification of the camphor vapor. Heat is then applied until the camphor melts, after which the temperature is carefully regulated so that vaporization takes place without violent ebullition. The camphor condenses on the lower surface of the lid in the form of a solid, circular cake. The iron cone is removed, from time to time, and the aperture in the cover cleared out with a knife, to permit of the escape of any excess of vapor. This affords an explanation of the hole seen at the centre of the cakes of camphor.

The foregoing definition of camphor calls for some explanation regarding the nature of a stearopten.

Proximately, volatile oils consist of two principles, differing in their point of volatilization or congelation, or in their composition. The solid constituent is the stearopten; the fluid constituent is the eleopten. It is impossible to separate them by distillation alone, so as to procure them free from admixture. When they congeal at different temperatures, they may be separated by compressing the frozen oil between folds of porous paper. The solid stearopten remains behind, while the fluid eleopten is absorbed by the paper, from which it may be separated by distillation with water. The solid, crystalline substances deposited by volatile oils on standing, are also called stearoptens. Some of them are called camphors, from their resemblance to true camphor; others are oxides or hydrates, analogous to the alcohols. Ordinary camphor is the stearopten obtained as already mentioned, and is a concrete volatile oil.

Purified camphor is usually in white, concrete, crystalline masses ; but it is also sold in rectangular blocks, and in the form of a powder, known as flowers of camphor. It is granular, semi-transparent, tough, and difficult to powder unless previously moistened with a little alcohol. The odor is strong, penetrating, and characteristic ; and its taste is pungent, bitter, and aromatic. It is lighter than water (in which it is sparingly soluble), but it dissolves readily in alcohol, ether, and in fixed and volatile oils. On the application of a moderate heat, it sublimes, so that bottles containing it are usually coated with condensed camphor on the sides least exposed to light. If left exposed to the air, it rapidly decreases in weight. It burns readily with a bright flame, giving off clouds of dense smoke. When small pieces of camphor are thrown into a basin of water, they revolve rapidly, and move about with more or less velocity in proportion to their size. These movements are supposed to be due to the force exerted by the vapor rapidly exhaled from the camphor on the surface of the water. If a pin-point, slightly smeared with oil, is dipped into the water, these movements instantly cease, and the particles of camphor are repelled from the pin-spot by the spreading film of oil.

There are three modifications of camphor, identical in composition and chemical properties, but differing in their action on polarized light. These are: dextro-camphor, which turns the plane of polarization to the right ; lævo-camphor, which turns it to the left ; and an inactive camphor, which has no action whatever on polarized light. The ordinary camphor is dextro-camphor.

Camphor has been variously regarded as an alcohol, a phenol, an aldehyde, and a ketone, the last view being the one most generally accepted.

When heated with nitric acid, camphor is oxidized and converted into camphoric acid.

THERAPEUTICS.—At Westminster Hospital, a largely-employed local application in cases of neuralgia is :

Chloral Hydrate,	1 part.
Menthol,	1 "
Thymol,	1 "
Camphor,	3 parts.

It is applied with a brush, and usually affords prompt relief.

When camphor is triturated with certain solid substances, they undergo mutual liquefaction and form a fluid. This is the case with chloral hydrate, menthol, thymol, and salol.

Camphor-water is simply a weak, watery solution. It is of uncertain strength, the amount of camphor dissolved varying with the temperature at which the preparation is kept. It is the common "camphor-mixture," given to hospital patients as a placebo when no definite line of treatment has been devised. It is harmless, and probably possesses no therapeutic virtues. Camphor lends its name to the camphorated tincture of opium or paregoric, although it plays but a subordinate part in its composition.

By far the most popular [British] preparation of camphor is the essence of camphor commonly known as "Rubini's Solution." It is not official, and is made by dissolving camphor in its own weight of absolute alcohol. It contains about a grain in two minims, and is a thoroughly reliable preparation ; being of the greatest use in the treatment of "summer diarrhœa," and the incipient stages of a cold. It should be employed with caution, the dose being from one to five minims every ten minutes or quarter of an hour, and subsequently less frequently.

Action.—Camphor has a very definite physiological action :

On Man.—Applied externally, it is a stimulant and rubefacient. A concentrated solution, rubbed into the skin, soon gives rise to a sense of heat accompanied by local redness. Applied to an abraded surface, it excites inflammation. In small doses, taken internally, it produces a sense of comfort, accompanied by a feeling of warmth. The pulse may be accelerated, although this is not always the case. Large doses give rise to lassitude, with giddiness, and a lowering of the pulse-rate. When from thirty to sixty grains are taken, the symptoms are faintness, headache, vertigo, confusion of ideas, burning pains in the stomach, nausea and vomiting, delirium, violent epileptiform convulsions, and maniacal excitement or insensibility, followed by general paralysis. The pulse is usually small, but may be accelerated; the skin is cold, pale or livid, and covered with sweat. The beneficial effects which follow the administration of small doses are probably due to stimulation of the cardiac muscle, and of the centre of respiration, and nerve-centres for the vessels. There is an acceleration of circulation and an increase of blood-pressure. The convulsions, to which reference has been made, are of an epileptiform nature. Alexander, after taking a dose of forty grains, experienced great mental confusion, accompanied by giddiness, and had a distinctly epileptic attack. As a rule, fairly large doses—say up to thirty grains—may be given without inducing anything more serious than giddiness and lethargy. At the same time it should be given with caution, especially if administered in a form in which it is rapidly absorbed.

Camphor is antiseptic, and has obtained reputation as a prophylactic against contagious diseases, although its virtues in this particular direction are open to question.

There is reason to believe that camphor, taken internally, sometimes induces glycosuria.

On Mammals.—In cats, laurel-camphor produces convulsions which are identical with those of epilepsy, and in one of which the animal usually dies. In rabbits, this action is not nearly so definite, nor are the symptoms so pronounced as with cats. In dogs, convulsions are not observed; but, after large doses, the animal exhibits great restlessness, and unsteadiness of gait. The nose and ears become markedly hyperæmic from dilatation of the cutaneous vessels. There is no psychical excitement, but, as the intoxication proceeds, the animal shows a great tendency to sleep. The sensibility to external impressions is diminished, but the spinal reflexes remain unimpaired. The symptoms must be referred, almost entirely, to the encephalon; the cord being but little affected, whilst the motor-nerves retain their excitability. It will be observed that the symptoms are very similar to those produced by alcohol.

On Frogs.—When a frog is placed under a bell-jar in which camphor has been sublimed, a series of symptoms is observed, indicating paralysis of the nervous system. The animal becomes lethargic, and exhibits a disinclination to make spontaneous movements, although it jumps well when touched. Soon its movements lack precision, and it falls over on its side when it attempts to jump. The pupils are contracted, and the respiration is slow and deep. After a time respiration ceases, it lies flaccid, and does not turn over when placed on its back. The spinal reflexes during this stage are good, and may be slightly exaggerated, but after a time they cease. The heart continues to beat for some time, but is finally arrested in diastole. From a consideration of these symptoms, it will be seen that, in frogs, camphor acts chiefly on the nervous system. The primary lethargy indicates early implication of the cerebrum; the loss of co-ordinating power indicates that the optic lobes and cerebellum are involved; and the inability to turn over, and the cessation of respiration, show that the paralysis has extended downward to the medulla oblongata. Finally, the spinal reflexes are abolished, and the motor nerves lose their excitability.

THERAPEUTICS.—Camphor is by far the best remedy we possess for the diarrhœa of summer and autumn, which so often assumes a choleraic form. The attack usually comes on suddenly, the patient suffering from persistent purging, often accompanied by vomiting. In half an hour, or even in a shorter time, his face assumes an anxious expression, the features are drawn, the lips are livid, the hands are cold, the pulse is weak or almost imperceptible, and the patient is practically in a condition of collapse. Camphor will set this right in a very few minutes. It is essential to use the strong solution or essence of camphor, which is a saturated solution of camphor in alcohol. Three minims should be given on a piece of sugar, or on crumb of bread, every five minutes. After one or two doses, the diarrhœa ceases, the pulse becomes stronger, color returns to the face, and the patient is on the high-road to recovery. The cure is completed by giving him two tablespoonfuls of brandy in half a tumblerful of iced milk, which he is to sip slowly. The essence of camphor is almost equally useful in the initial rigor of the acute specific diseases, and in a severe chill. Inhaled, and taken internally, it is of service in the early stages of a cold in the head.

ALLIES.—Camphor ($C_{10}H_{16}O$) is closely allied in physiological action to borneol ($C_{10}H_{18}O$), and to menthol ($C_{10}H_{20}O$). This group is also allied to the alcohol group, the similarity being most marked in the case of menthol. As the number of hydrogen atoms diminishes, there is an increased tendency to the production of convulsions of cerebral origin.

There is a derivative of laurel-camphor known as *monobromide of camphor* or monobromated camphor ($C_{10}H_{15}OBr$), which, in action, is very closely allied to borneol. A few years ago an attempt was made to introduce it as a remedy, and for a time it was largely employed; but, little by little, it dropped out of use, and is now rarely prescribed, probably because it is taken with difficulty, and is apt to irritate the stomach.

[PREPARATIONS.—Aqua Camphoræ; Linimentum Camphoræ; Linimentum Saponis; Spiritus Camphoræ; Tinctura Opii Camphorata.]

TURPENTINE

Turpentine is an oleoresin obtained from various species of pine. Those which are most commonly the source are:

Pinus australis or *Pinus palustris*, the broom-pine or swamp-pine of the United States. In the Southern States it is known as the long-leaved pine, yellow pine, or pitch pine. It furnishes by far the greatest portion of the turpentine and tar consumed in or exported from America.

Pinus tæda, the loblolly or oldfield pine, which abounds in the neighborhood of the coast from Virginia to Florida, yields turpentine in abundance; but the product is less fluid than that obtained from the last-named species.

Pinus pinaster or *Pinus maritima*, which grows in the southern and maritime parts of Europe, yields most of the turpentine, pitch, and tar consumed in France.

Pinus sylvestris, from the northern and mountainous parts of Europe, is identical with the Scotch fir, and yields much of the common turpentine.

Turpentine may also be obtained from other kinds of pine and fir. In some species, the oleoresin exudes spontaneously; but turpentine is usually obtained for commercial purposes by incising or wounding the trunks of the trees. There are many other kinds of turpentine, as, for example, Chian turpentine, an oleoresin which flows from the trunk of *Pistacia Terebinthus* and is imported from Chio. It was introduced, in 1880, as a remedy for cancer of the uterus, but demand for it is now small.

To obtain the oil, crude turpentine is distilled, the process being continued as long as any turpentine passes over. The residue is resin or rosin. On condensing the distillate, the oil separates from the water, and, after being rectified, is collected in barrels.

Oil of turpentine, commonly known as spirit of turpentine, is a mixture of several hydrocarbons having the formula $C_{10}H_{16}$. It is limpid and colorless, and has a strong, penetrating, peculiar odor, a hot, bitterish taste, and a neutral or faintly acid reaction. It is slightly soluble in water; less so than most of the other volatile oils, and is readily soluble in ether. It has the peculiar property of absorbing oxygen and converting it into ozone [in the presence of sunlight; which is also the case with some other essential oils]. When pure, it consists entirely of carbon and hydrogen; but exposed to the air, it absorbs oxygen, becomes thicker, yellowish in color, and loses much of its activity through the formation of resin.

It is highly inflammable, and, when brought in contact with a mixture of nitric acid and sulphuric acid, it readily catches fire. When heated with hydrochloric acid, it assumes a red color; a white, crystalline substance being at the same time formed which, from its resemblance to camphor, has received the name of artificial camphor.

As procured from different sources, oil of turpentine shows great difference in optical behavior. The American and German oils of turpentine turn the ray of polarized light to the right, while the French oil turns it to the left. It is generally supposed that these two forms of turpentine are identical in action, but they differ somewhat.

ACTION.—When oil of turpentine is applied to the skin, it acts as an irritant and rubefacient. It may, especially if evaporation be prevented, act as a vesicant.

Taken internally, it produces a feeling of warmth in the stomach, followed in a few minutes by a sense of exhilaration, and, if the dose is a large one, by giddiness and a kind of intoxication.

After absorption, it causes a rise and then a fall of blood-pressure, due, in all probability, to its first stimulating, and then paralyzing the vaso-motor centres. The effect on the pulse is uncertain, for it is sometimes slowed and sometimes quickened in frequency. Doses which have no effect on the blood-pressure may increase the frequency of the pulse. This effect is probably due to a direct action on the heart itself. Large doses commonly slow the pulse, and this is believed to be due to stimulation of the pneumogastrics. Respiration is quickened, and a portion of the drug is eliminated by the mucous membrane of the bronchial tubes.

The use of oil of turpentine as an antidote to phosphorus, calls for a word of explanation. When it is kept for some time in bottles partially filled with air, it absorbs ozone, and acquires the power of converting phosphorus into hypophosphoric acid. It is essential to the treatment of poisoning by phosphorus that the turpentine should contain plenty of ozone, or it will exert anything but a beneficial effect, and will facilitate the absorption of the phosphorus by dissolving it. It is usually said that the French oil of turpentine should be used as an antidote in such cases, and that the German and American varieties are useless.

The irritant action of oil of turpentine on the kidneys and genito-urinary organs is very decided. The first symptom is an increase in the amount of urine secreted. This is followed by pain in the back, frequency of micturition, and scalding in the urethra. After a time the quantity of urine secreted is diminished, it contains albumin, and is blood-stained. The urine also acquires an odor of violets.

Large doses of oil of turpentine are vermifuge, and exert a purgative action.

THERAPEUTICS.—As a counter-irritant, in the form of a liniment, turpentine is largely employed in the treatment of chronic rheumatism, sprains, sore throat, neuralgia, and a number of painful affections. The following is a useful formula:

Turpentine Liniment,	℥ j.
Water of Ammonia,	℥ j.
Oil of Cajuput,	℥ ss.
Oil of Lemon,	ʒ j.
Olive Oil,	to ℥ iv.

For hæmoptysis there is no better remedy than oil of turpentine. It should be inhaled freely from the hands or from a pocket-handkerchief. It is useful in the intestinal hæmorrhage of typhoid fever. Even when there is no hæmorrhage, it is useful about the end of the second week, when the tongue becomes very dry, red, chapped, and coated in the centre with a brownish fur; and when, in addition, there is marked flatulent distension of the abdomen. Ten drops may be given, every four hours, in mucilage of acacia, mixed with half a drachm of glycerin, and flavored with two drops each of oil of erigeron[1] and oil of gaultheria.

ALLIES.—There are many substances allied in general action to turpentine. One of the best known of these is

Terebene. It is a clear, colorless fluid, having an aromatic odor, and is made by the action of sulphuric acid on oil of turpentine, with subsequent distillation. It is a powerful antiseptic, and is largely employed in the treatment of flatulence and winter-cough.[2] It may be given internally in ten-drop doses, on a piece of sugar or on bread-crumb, every four hours. It may also be used as a spray, either with a common atomizer, or with one in which steam is used to create a spray.

Pinol is made from the Pumilio-pine, growing in Alpine regions above the snow-level. In therapeutical action it is closely allied to terebene, but is more fragrant. A mixture of terebene, pinol, and eucalyptol will be found useful in winter-cough, not only by internal administration, but to inhale, either with or without an apparatus.

Terpin-hydrate is a derivative of oil of turpentine, and is generally met with in prismatic crystals, resembling chloral hydrate. It is very insoluble in water, and is best given in the form of tablets.

[PREPARATIONS.—Linimentum Terebinthinæ; Oleum Terebinthinæ Rectificatum.]

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[1] [Recent investigations by Professor Henry G. Piffard, of New York, warrant belief that oil of erigeron exists only in name.]

[2] MURRELL: "Chronic Bronchitis and its Treatment," 1889.

TANNINS:

TANNIC ACID—GALLIC ACID—KINO—CATECHU

These are all astringents. Astringents may be roughly defined as substances which check or dry up secretions. Most of them cause contraction of the tissues to which they are applied, and their action is exerted chiefly on the mucous membranes. Some astringents are purely local, others are remote in their action. Local astringents affect solely the parts to which they are applied, while remote astringents act on distant organs after their absorption into the blood. Most of them—excepting gallic acid and ergot—coagulate or precipitate albumins.

We have many examples of astringents. Most of the acids exert an astringent action. Alcohol in all forms is distinctly astringent, and so is alum. Many metallic salts are astringent, and good examples are found in sulphate of copper, perchloride of iron, and nitrate of silver. Gallic acid and tannic acid belong to this class, and many vegetable substances which contain them—such as kino and catechu—are decidedly astringent.

Tannic acid and gallic acid are both derived from galls—excrescences found on the small twigs of a species of oak (*Quercus Lusitanica*), and are produced by the puncture and deposited eggs of an insect, being, in this sense, of animal origin.

Tannic acid (or tannin) is prepared by the action of ether on galls. It is a glucoside, and is met with in the form of glistening, yellow crystals, freely soluble in water and having an astringent taste.

Gallic acid is prepared by the action of sulphuric acid on galls [or upon tannic acid]. It is met with in the form of white or pale, fawn-colored, acicular crystals, soluble in cold water and freely soluble in hot water.

Kino is the juice, hardened in the sun, of the incised bark of *Pterocarpus Marsupium*—the East Indian kino.

It contains kino-tannic acid and pyrocatechin, which differs very slightly from the catechin obtained from catechu.

Catechu is an extract from the wood of the *Acacia Catechu*, and contains catechu-tannic acid, which differs from other forms of tannin in not being a glucoside.

These substances belong to the group of tannins and, in spite of very many essential chemical differences, agree in the fact that they form stable compounds, of the nature of leather, with the gelatin-yielding constituents of tissues, and, at the same time, precipitate albumins and gelatin from their solutions.

ACTION.—Tannin, applied to skin deprived of its epidermis, coagulates the albumin. It also coagulates the blood and acts as a styptic. Applied to the mucous membrane, it coagulates the mucus, but does not contract the blood-vessels, its astringent action being due to the coagulation of the albumin of the tissues with which it is brought in contact. Taken into the stomach, it acts as an irritant and gives rise to vomiting. Taken in ordinary medicinal doses, by the mouth, it rapidly combines with the albuminous substances met with in the stomach, and but little of it finds its way into the intestine. It is not improbable that the albuminous compound is again decomposed by the alkali of the blood, and so exerts a remote astringent effect. Substances, such as catechu, which contain some form of tannin guarded by gummy and extractive matters, are not so easily decomposed by the stomach, and pass more readily into the intestine.

Tannin breaks up in the blood and is eliminated by the urine in the form of gallic acid and pyrogallic acid. When an astringent action on the kidneys is required, it is better to use gallic acid and not tannic acid—the acid and not the glucoside. Gallic acid passes unchanged into the urine, and has been detected an hour after being taken. Catechu-tannin also passes off in the urine, unchanged.

Gallic acid differs from tannin in not coagulating albumins.

Kino is insoluble, and exerts its astringency chiefly on the lower part of the intestine.

The Therapeutical Uses of tannic acid, and of other members of this group, will be divined from a consideration of their physiological action. They are employed whenever an astringent or a styptic is indicated.

I have recently employed the following formulas, with much success, to check profuse sweating, especially when its odor is offensive :

Tannic Acid,	gr. xx.
Terebene,	ʒ ij.
Absolute Alcohol,	to ℥ ss.

The next formula is a modification of the foregoing :

Tannic Acid,	gr. xx.
Oil of Pumilio Pine,	ʒ ij.
Absolute Alcohol,	to ℥ ss.

The latter is especially a pleasant preparation. Either of them, painted on the affected part at bedtime or in the morning, will effect a cure in a few days.

The preparations of these substances call for but little comment. The glycerin of tannic acid is a useful application for the throat, and is largely employed in chronic tonsillitis, relaxed uvula, and similar affections, and should be swabbed freely all over the affected parts with a large brush. It is not altogether a pleasant mode of treatment, but it is efficacious. Glycerin of gallic acid answers much the same purpose. Glycerin of tannin is also used as a local application to eczematous surfaces which secrete profusely.

Tannic acid is also useful in stomatitis and ulceration of the gums. Given internally, it may be administered with advantage in hæmoptysis, hæmatemesis, and intestinal hæmorrhage. It lessens the amount of albumin passed in albuminuria.

The compound kino powder [official in Great Britain, but not in United States] contains opium, and is a favorite remedy for the diarrhœa of phthisis.

[PREPARATIONS: *Tannic Acid.*—Collodium Stypticum; Glyceritum Acidi Tannici; Trochisci Acidi Tannici; Unguentum Acidi Tannici.

Kino.—Tinctura Kino.

Catechu.—Tinctura Catechu Composita; Trochisci Catechu.]

HAMAMELIS

Hamamelis virginiana, or witchhazel, is a shrub, five to fifteen feet high, which grows more or less abundantly in all parts of the United States; chiefly on hills and stony places, or on the banks of streams. It is remarkable for the late appearance of its yellow flowers, which expand in autumn and continue to blossom until the depth of winter. The branches have been employed from time immemorial as "divining rods." The bark appears to have been employed by the Indians, in the form of a poultice, as a remedy for tumors and inflamed surfaces. The parts used in modern medicine are the leaves and the bark.

The bark contains about seven per cent. of tannin, with a certain amount of resin, sugar, mucilage, and the ordinary constituents of woody fibre. No alkaloid or glucoside has been detected. The substance known as hamamelin or hamamelidin, is not an alkaloid, but a resinoid substance, made by adding a concentrated, alcoholic fluid-extract of the drug to a large quantity of water, and collecting the precipitate.

The official preparation of hamamelis is the fluid-extract made from leaves [collected in the autumn]. An ointment of hamamelis may be made by mixing one part of the fluid-extract with nine parts of simple ointment.

A very dilute (6 per cent.) alcoholic preparation, distilled from the fresh plant, is a reliable form in which to administer the drug. and has a much larger sale than any of the official preparations [owing, it is said, to the fact that the active principle (whatever that may be) is not present in the alcoholic preparations].

Respecting the pharmacological action of this drug we are completely in the dark. It has no poisonous action, and even large doses, administered to animals, produce no effect. It has been suggested that its therapeutical action is due to the presence of tannin; but, as "Hazeline" [as well as other commercial forms] is prepared by distillation, and as tannin is not volatile, this can hardly be the case.

Therapeutics.—Hamamelis is extensively employed for checking hæmorrhage, especially when venous in character. It is most useful in what is called passive hæmorrhage, and is of much value in the treatment of menorrhagia and dysmenorrhœa. There is no doubt as to the utility of hamamelis, and especially of "Hazeline" ["Pond's Extract" and the like], in the treatment of bleeding piles. It should be given internally, and employed locally as an ointment. When the bleeding is profuse, it may be injected into the bowels.

It is said that hamamelis will cure varicose veins, and I have no doubt that in these cases it is frequently of much benefit and obviates the necessity for an operation. It is slow in its action, and, in many cases, I have found it necessary to give it continuously for a year or more. I have had patients whom I should not hesitate to call skilled observers, who, from personal experience of its effects in the treatment of varicose veins, have been convinced of its utility.

The prescription I usually employ is the following:

Hamamelidin, gr. ¾

To make a pill. One to be taken every three hours.

An ointment is made with five grains of hamamelidin to an ounce of lanolin ointment, and may be scented with a few drops of oil of rose-geranium.

[Preparation.—Extractum Hamamelidis Fluidum.]

BENZOIC ACID

Benzoic acid is usually prepared from benzoin by sublimation. Benzoin is a balsamic resin obtained by deeply incising the bark of the *Styrax Benzoin*, or benjamin-tree, a native of Sumatra and Java. The name "benjamin" is probably a corruption of the Arabic term *lubân jáwi*, meaning Javanese frankincense.

The mode of preparing benzoic acid by sublimation is worth noting; most acids being prepared by liberating them from their alkaline salts by means of sulphuric acid. Benzoic acid exists in benzoin, combined with resin, and is volatilized and then condensed in the upper part of the apparatus employed. The temperature is carefully regulated to prevent decomposition of the resin. Benzoic acid may also be obtained from the urine of horses and cattle, by boiling the hippurate of calcium with hydrochloric acid.

Benzoic acid occurs in the form of light, feathery, crystalline plates or needles; having a silky lustre, a warm, acrid taste, and an agreeable, aromatic odor, resembling that of the benzoin from which it is obtained. It is sparingly soluble in water; but dissolves readily in alcohol, fats, and oils. When mixed with solutions of the alkalies, or with lime, it forms benzoates, from which it may again be separated by the addition of hydrochloric acid.

USES.—Benzoic acid is a powerful antiseptic. This fact affords an explanation of the popular use of "Friar's balsam" (compound tincture of benzoin) as an application to wounds.

It is a stimulating expectorant, and this, again, affords an explanation of the value of Friar's balsam in the treatment of coughs.

Benzoate of sodium and benzoate of ammonium are powerful hepatic stimulants, but exert no action as regards intestinal secretions.

Benzoic acid is a diuretic and renders the urine acid. In the kidneys, it unites with glycin, and is excreted in the form of hippuric acid. That the seat of the change is in the kidneys, is demonstrated (as Brunton has shown) by the following experiments:

Benzoic acid, when administered, is found in the urine as hippuric acid, but in the blood it still remains as benzoic acid.

Given to a rabbit, hippuric acid is excreted as such, but is found in the blood as benzoic acid.

If the renal arteries are ligatured and benzoic acid be given, no conversion into hippuric acid takes place; but if the ureters be ligatured, the change takes place, and hippuric acid is found in the blood.

It seems probable that the cells of the kidney-tubules have the power of effecting a combination between the benzoic acid brought to them by the blood, and the glycin which they form by their own metabolism. Many other bodies, taken into the system, reappear in the urine combined with glycin, the change in each case taking place through the activity of the cells of the tubules.

Benzoic acid is allied in action to salicylic acid and other acids of the aromatic series.

[PREPARATIONS: (of the balsamic resin) Adeps Benzoinatus; Tinctura Benzoini; Tinctura Benzoini Composita.]

COPAIBA

Copaiba or copaiva is an oleoresin obtained by incising the bark of *Copaifera Langsdorffii* and other species of *Copaifera,* natives of the warmer climates of South America. It is a more or less viscid liquid, usually transparent and not fluorescent, but sometimes opalescent and slightly fluorescent. It varies in color from a light-yellow to a pale golden-brown. It has a peculiar, aromatic odor, and a persistent, acrid, and somewhat bitter taste. It is soluble in absolute alcohol and in petroleum. From it is obtained, by distillation, the oil of copaiba, a colorless or pale-yellow fluid, having the odor and taste of copaiba.

ACTION.—In ordinary therapeutic doses, copaiba exerts very little action on the general system. In large doses, it gives rise to an increased flow of saliva, with flatulence and colic. This may be accompanied by a sensation of heat in the throat and at the pit of the stomach, loss of appetite, nausea, and purging with violent tenesmus. It often induces irritation of the larynx, with a dry, painful cough and the expectoration of semi-purulent, greenish, nauseous mucus.

It is a powerful diuretic, and is frequently employed in the treatment of Bright's disease. It imparts its characteristic odor to the urine, and, on the addition of nitric acid, a precipitate is formed resembling that of albumin, with the exception that it clears up on the application of heat. This precipitate consists of the oxidized oil united with some of the urinary principles. A new substance has been detected in the urine of patients taking copaiba, which has been named "copaiba-red," and has the property of reducing oxide of copper. The copaiba may be extracted from urine by shaking it up with ether. The urine, when copaiba has been taken, does not undergo decomposition so readily as under ordinary circumstances. It remains for a longer time clear, and even when triple phosphates are ultimately deposited and the surface is covered with a film, putrefactive bacteria are either absent or are present in small numbers. To this particular property of copaiba we are indebted for its employment in the treatment of gonorrhœa and gleet. Ordinarily the few drops of urine which remain in contact with the mucous membrane of the urethra, after the bladder is emptied, speedily undergo decomposition, and prevent progress toward recovery.

Copaiba produces, when taken internally, a rash which may be an urticaria, but more commonly resembles the eruption of measles. It does not begin on the face and extend downward over the body, but is patchy and exhibits a preference for the neighborhood of the joints. It is not accompanied by elevation of the temperature; but is usually attended with intense itching, sore throat, diarrhœa, and vomiting.[1] In doubtful cases an examination of the urine will throw light on its nature.

Most ethereal oils are eliminated with the urine, but this is not the case with copaiba, its volatile oil being destroyed in the body ; only the resinous acid appearing in the urine.

Copaiba is frequently adulterated with Gurjun oil.

Gurjun Balsam, or wood-oil, is a balsamic exudation obtained by incision, and application of heat, from the trunk of *Dipterocarpus turbinatus,* and other species, growing in the East Indies. It is a transparent liquid of the consistence of olive oil, of opaque, dingy, greenish-gray color (as seen by reflected light), and has an aromatic odor and taste not unlike copaiba, but without its acridity. It sometimes (but very rarely) produces a rash.[2] It has all the advantages of copaiba as an expectorant, without the grave disadvantage of exciting an eruption.

THERAPEUTICS.—Balsam of copaiba, in doses of from ten to fifteen grains, is largely employed as a diuretic in cases of ascites, and in the œdema resulting from Bright's disease. The following mixture has for many years been in use in Westminster Hospital :

Copaiba Resin,	gr. x.
Diluted Alcohol,	♏ xv.
Spirit of Chloroform,	♏ x.
Syrup of Ginger,	♏ xl.
Mucilage of Acacia,	♏ lxxx.
Water,	to ℥ j.

Some surgeons trust entirely to the internal administration of copaiba, cubebs, and oil of sandal-wood in the treatment of gonorrhœa ; giving them even in the earlier stages, and to the exclusion of injections. Capsules containing these, either alone or mixed in various proportions, are kept in stock by most pharmacists.

[PREPARATIONS.—Massa Copaibæ ; Resina Copaibæ.]

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[1] MURRELL : Lancet, 1890, vol. i, p. 568.

[2] Ibid.: p. 962.

CUBEB

Cubebs are the unripe fruits of *Piper cubeba*, a climbing-plant of Java and of other parts of the East Indies, where it is extensively grown in coffee-plantations. It differs from black pepper (which it closely resembles) in having a stalk about half an inch long. Its odor is strong and peculiar, and its taste is warm, aromatic, and somewhat bitter. Cubeb is a complex substance; but there is no doubt that the ethereal-extract or oleoresin, as it is called, represents its peculiar properties. This oleoresin contains:

Oil of cubeb—a colorless or pale, greenish-yellow fluid. As it is volatile, and as it is on the presence of this substance that the activity of the drug mainly depends, it is better that cubeb should not be powdered until actually required for use.

Resin—a brown, soft, acrid substance—probably formed by the oxidation of the above.

Cubebic acid—an acid which is nearly tasteless and which forms salts with bases. The cubebate of magnesium is a convenient form for administration.

Cubebin—a neutral, crystallizable substance, analogous to piperin obtained from black pepper. It is probably physiologically inert.

ACTION.—In small doses, cubeb acts as a stimulant to the gastric mucous membrane, increases appetite, and improves digestion; but when larger doses are taken, the patient experiences a sensation of warmth at the pit of the stomach, and, not infrequently, suffers from giddiness and headache. The skin is hot, and the pulse is increased in frequency. After very large doses, there may be nausea, vomiting, colicky pains in the abdomen, and purging.

Cubeb is a stimulating expectorant, and is frequently smoked, in the form of cigarettes, by asthmatics and chronic bronchitics. It excites an eruption which is similar to that produced by copaiba, and is not accompanied by febrile disturbance. It increases the secretion of urine, to which it imparts its characteristic odor. On the addition of nitric acid to such urine a precipitate is produced, which differs from that of albumin in clearing up on the application of heat.

THERAPEUTICS.—The most convenient preparation of cubeb for internal use is the tincture.

Cubeb is an excellent remedy for bronchial catarrh and chronic bronchitis. Many sufferers from the latter affection adopt the following mode of treatment: A cup of linseed tea is flavored with a slice or two of lemon, and to this is added a teaspoonful of the tincture of cubeb. It is placed in the front of the fire to keep it warm, and is slowly sipped while they read the paper after breakfast. It produces copious expectoration, and the patient is free from trouble for the rest of the day.

In many chronic bronchial affections, much benefit is derived from inhaling a mixture of oil of cubeb, oil of sandal-wood, and oil of lemon.

It is not a bad plan to smoke cubeb for chronic bronchitis, and cubeb-cigarettes have a ready sale during the winter months. In hospital practice we use dried, powdered cubeb, the patient smoking it in his pipe, either alone or with a little tobacco. The smoke stimulates the mucous membrane, and the mouth is hot for some time afterward.

It is usually said that cubeb is useful in the early stages of gonorrhœa, and copaiba later on when it has become more matured.

[PREPARATIONS.—Extractum Cubebæ Fluidum; Oleoresinæ Cubebæ; Tinctura Cubebæ, 1 Gm. in 10 Cc.

Of the oleoresin: Trochisci Cubebæ.]

COLCHICUM

[*Colchicum autumnale* or meadow saffron is a plant which grows in moist, rich meadows in Northern Africa, Middle and Southern Europe, and abundantly in England and Ireland; but is not found in the United States.] The parts which are official are the corm and the seeds.

ACTIVE INGREDIENTS.—Colchicum contains colchicine, a crystalline alkaloidal principle, formerly supposed to be identical with veratrine, the active principle of sabadilla or cebadilla. It differs from it in having a less burning taste, and in being more freely soluble in water and soluble in alcohol. Colchicum contains, in addition, cevadic acid, fatty and gummy matters, a fixed oil, and, possibly, traces of veratrine.

All parts of the plant are active, and it is a matter of no practical importance whether preparations of the corm or of the seeds are employed.

ACTION.—In man, full doses produce repeated, uncontrollable vomiting accompanied by much retching. Purging is common; the motions being at first serous, then mucous, and finally mixed with shreds of membrane and perhaps blood. There is a burning sensation in the stomach, and there may be griping. Muscular pains are experienced, and there is great muscular weakness, so that the sufferer is hardly able to walk. After large doses, the heart becomes weak; the pulse is feeble, rapid, and thready, and the skin cold, pallid, and livid. Sometimes there is an increase in the amount of urine passed, and at others it is almost suppressed. Death ensues from collapse, the brain remaining clear to the last. Colchicum exerts the same effect on the alimentary canal, whether taken by the stomach or injected subcutaneously.

By some observers it is stated that there is an increased elimination, both of urea and uric acid, while by others this is denied. It is possible that difference in the dietary of patients may account for this discrepancy.

In the lower animals, the symptoms produced are much the same as in man: Purging, vomiting, great prostration, embarrassed respiration and, finally, more or less complete paralysis and death, preceded by convulsions. *Post-mortem*, the blood is found to be dark in color and imperfectly coagulated, and the mucous membrane of the intestines is swollen and intensely congested.

In frogs, reflex action is lessened and finally abolished; the motor nerves and voluntary muscles are not affected; but there is a decided action on the higher motor centres, the spinal cord, and the peripheral sensory nerves. The circulation is affected, but the action is to a great extent reflex; for when the drug is injected directly into the circulation, the heart and the blood-pressure are but slightly affected. After very large doses, the inhibitory nerves of the vagus are found to be paralyzed. In its action on the stomach and intestines, colchicum is allied to emetine.

It is difficult to deduce, from its pharmacological action, any rational explanation of the value of colchicum in the treatment of gout and its various manifestations.

THERAPEUTICS.—Colchicum is a remedy of undoubted value in gout and in the gouty diathesis. The wine is, on the whole, the most satisfactory preparation. In out-patient hospital practice, acute gout more commonly presents itself in the form of chiragra rather than of podagra, the explanation being that when the feet are involved a patient is unable to walk to the hospital. In these cases I usually prescribe half a drachm to a drachm of the vinum colchici, with ten grains of iodide of potassium, in a mixture to be taken three times a day. The affected joints are painted with equal parts of extract of belladonna and glycerin, and are enveloped in cotton-wool. The drachm-doses of colchicum wine are reserved exclusively for able-bodied men of the brewer's-drayman description. The effect is marvellously good as regards the gout, a patient usually being able to resume work on the third day; but the treatment is severe, and produces persistent purging, not uncommonly accompanied by vomiting.

In less severe cases I give ten minims of the colchicum wine, with five grains of iodide of potassium, in a mixture flavored with spirit of chloroform and syrup of orange-flower, three times a day. Even this dose often acts as a laxative, and produces a peculiar, metallic taste in the mouth. Many gouty patients take this mixture at intervals, all the year round, giving themselves a few days' treatment on special occasions, such as after a big dinner or an exceptional indulgence in wine. For private patients, a visit to Aix-les-Bains, and a three-weeks' treatment, once a year, under the kindly supervision of Dr. Brachet, usually works wonders.

Colchicine is a valuable remedy and, in conjunction with small doses of calomel, may be prescribed with advantage for gouty people who have had no acute manifestation of the disease, but who suffer more or less continuously from joint-pain. The following is a useful formula:

Colchicine,	gr. $\frac{1}{60}$.
Calomel,	gr. $\frac{1}{2}$.
Extract of Hyoscyamus, to	gr. j.

This is made into a pill, and one is to be taken at bedtime, or three times a day after meals, according to the severity of the symptoms.

Dr. C. D. F. Phillips has furnished me with the following formula, which he has found useful in the treatment of gouty neuritis and allied affections:

Colchicine,	gr. $\frac{1}{80}$.
Sulphate of Quinine,	gr. j.
Extract of Colocynth,	gr. j.

To make a pill: one to be taken three times a day.

[Preparations.—Extractum Colchici Radicis; Extractum Colchici Radicis Fluidum; Vinum Colchici Radicis, 1 Gm. in 2.5 Cc.; Extractum Colchici Seminis Fluidum; Tinctura Colchici Seminis, 1 Gm. in 6.67 Cc.; Vinum Colchici Seminis, 1 Gm in 6.67 Cc.]

SQUILL

The official scilla or sea-onion is a very old remedy. Egyptians worshipped it; Epimenides, who lived in the 30th Olympiad, made much use of it; Theophrastus praised its virtues; Hippocrates used it externally, internally, and as a pessary; Pythagoras wrote a volume on it; and Dioscorides invented the vinegar of squill. In spite of this it is now a comparatively rarely-employed remedy.[1] It is the bulb of the *Urginea maritima*, divested of its dry, membranous outer scales, and cut into slices. Its active principle is a glucoside, scillitoxin or scillaïn, a substance having many of the properties of digitalis.

Squill has a bitter taste and, in full doses, excites nausea, vomiting, and diarrhœa, the motions being watery and often mixed with blood. It slows the pulse, raises the blood-pressure, and arrests the heart in diastole. It is a member of the digitalis group, and is allied in general action to adonidin, oleandrin, and apocynin.

Therapeutics.—Squill is an expectorant and is employed chiefly when the secretion is profuse and difficult to expel. Like digitalis it acts also as a diuretic, and is reputed to be of much use in the treatment of cardiac dropsy.

[Preparations.—Acetum Scillæ; Extractum Scillæ Fluidum; Tinctura Scillæ; Syrupus Scillæ (from vinegar of squill); Syrupus Scillæ Compositus (from fluid-extract).]

MALE FERN—SANTONIN—ETC.

These drugs are employed chiefly as anthelmintics—medicines which kill or cause the expulsion of intestinal worms. Anthelmintics are sometimes subdivided into vermicides (those which kill) and vermifuges (those which expel) the worms; but there is not much difference between them It is of importance to bear in mind that there are many different kinds of intestinal worms, for a drug which proves deadly to one class may be utterly inefficacious for another. Roughly speaking, there are about twenty-one different kinds of worms which are known to infest the intestinal canal. They may be divided into three classes:

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[1] [In the United States it is still used in expectorant mixtures.]

Flat- or *Tape-Worms.*—The common forms are *Tænia solium*, the pork tape-worm, and *T. mediocanellata*, the beef tape-worm. A mutton tape-worm, *T. tenella*, is also described, but is not very common.

Round-Worms.—The round-worm, *Ascaris lumbricoides*, inhabits the small intestine, but is fond of travelling, and frequently manages to make its way into other channels.

Thread-Worms or *Seat-Worms.*—The common species is the *Oxyuris vermicularis;* they inhabit the rectum, especially of children, and are usually met with in large numbers.

The drugs commonly employed as anthelmintics are: Male fern, santonin, pomegranate-root bark, koosso, kamala, areca nut, and turpentine.

In addition to these, calomel, scammony, and various other purgatives are employed for the expulsion of thread-worms, whilst salt and water, perchloride of iron and water, and infusion of quassia are used as enemata for the same purpose. When children suffer from worms, it is essential, in order to prevent a recurrence, to improve the condition of general health by an administration of such remedies as cod-liver oil, extract of malt, Parrish's chemical food, and the like. Cold sponging, good feeding, and plenty of outdoor exercise are useful adjuncts.

MALE FERN

This is the rhizome, with the adherent bases of the petioles, of the *Aspidium filix mas*, the common male shield fern. The use of male fern as a vermifuge was known to the ancients, and is referred to by Theophrastus, Dioscorides, and Pliny. It is mentioned in Schröder's Dispensatory (1656), and in other works published about the same time. Toward the end of the eighteenth century a Madame Nuffer, or Nuffler, widow of a Swiss surgeon, obtained reputation for curing tape-worm by means of a specific, and, in 1775, sold her "discovery" to Louis XIV. for 18,000 livres. Her method consisted in the administration, in the following order, of: A panada made with bread and a little butter; a clyster of salt water and olive oil; the *specifique*, composed of two or three drachms of the powdered male fern, in from four to six ounces of water; a purgative bolus, composed of ten grains each of calomel and scammony, and six or seven grains of gamboge. The male fern was given the first thing in the morning, on an empty stomach, and the purgative followed two hours later.

The ACTIVE PRINCIPLE of male fern is filicic acid, a crystalline substance. Traces of a volatile oil, together with tannin, resin, and a little sugar, are also met with.

The male fern is fatal to all kinds of tape-worm. It is essential that it should be given on an empty stomach, for if the stomach and intestines are loaded with food it is not brought in contact with the parasite. The cure is usually effected in a single day. The patient should take nothing but a cup of tea after his lunch or mid-day meal; at bedtime he is to take an ounce of castor-oil; and in the morning, half a drachm of oil of male fern, made into a mixture with a drachm of mucilage of acacia, fifteen minims of syrup of ginger, and an ounce of water; to be followed, in a couple of hours, by another dose of castor-oil. This rarely fails to expel the head of the worm and effect a cure. Cobbold gives elaborate rules for the treatment of tape-worm with male fern; but if these simple directions are followed, no difficulty is experienced. In over-doses, aspidium acts as an intestinal irritant, and may cause death.

[PREPARATION—Oleoresina Aspidii.]

SANTONIN

Santonin is a crystalline principle obtained from santonica, the dried, unexpanded flower-heads of *Artemisia maritima*, imported from Russia. The great emporium for the worm-seed is the fair at Nijnii Novgorod, whence it is conveyed, *via* Moscow and St. Petersburg, to Western Europe. Santonin is insoluble in water, but slightly soluble in alcohol and oils, and undoubtedly represents the activity of the plant.

ACTION.—Santonin exerts a powerful action on the nervous system, and there are several cases on record of poisoning by it. After large doses, patients complain of headache, lassitude, prostration, flashes of light before the eyes, hallucinations of smell and taste, pain in the region of the stomach, nausea and vomiting, trembling in the limbs, and convulsive twitchings and movements of the muscles of the face, eyes, and jaw. Administered to dogs and rabbits, it gives rise to accelerated breathing, slowing of the pulse, trembling, cramps, free salivation, unconsciousness, convulsions, dilated pupils, and death.

There are two symptoms produced by santonin which are deserving of special note. The first of these is a peculiar disturbance of yision; everything appearing to the patient at first of bluish, and then of yellowish, or greenish-yellow color. This condition is technically known as xanthopsia or chromatopsia, and is due to stimulation and subsequent paralysis of those fibres of the retina by which blue light is perceived. The other symptom is the effect of the drug on urine, which it colors bright-yellow, or, if the urine is alkaline, bright-red. The discoloration is due to some product of the oxidation of santonin.

THERAPEUTICS.—Santonin is employed almost exclusively for the expulsion of the round-worm; has no effect on the tape-worm, and its influence on thread-worms is very slight. It has a great advantage in being tasteless and odorless, so that it can be given without difficulty.

The dose is from two to five grains, every alternate night at bedtime, followed by a purgative in the morning.

[PREPARATION.—Trochisci Santonini.]

ERGOT

Among the lowest forms of vegetable life, and distinguished from other plants by the absence of chlorophyll, are the fungi. There are usually two stages in the life of a fungus: In the first, or vegetative period, it exists as a mycelium, a filamentous mass, the sole function of which is to grow and increase; in the second stage, the thallus, or ordinary fungus or mushroom, is formed, the function of which is to develop reproductive bodies and reproduce its species, after which it perishes. In the case of some fungi there is an intermediate stage known as the sclerotium. The genus *Claviceps* comprises a number of parasitic fungi, which develop in the pistil of various kinds of grass.

Official ergot is the sclerotium of *Claviceps purpurea*, which infests the grain of *Secale cereale* or rye. Rye, when attacked with the fungus, is called spurred rye—*Secale cornutum*. The fungus makes its appearance during the early days of the pistil, and is first seen at the base as a flocculent mass—this is the mycelium. These filaments grow and invade all parts of the tissue of the pistil, until they form a white mass, on which the dark sclerotium soon makes its appearance. As it grows, it lifts up before it the remains of the withered and blackened pistil, and casts it away, forming ergotized rye.

The etymology of the word ergot is doubtful. It was originally written "argot." In the dictionary of the Paris Academy *ergot* is given as the French word for the spur of a cock or the claws of a dog, and it is probable that the drug is called ergot from its resemblance to a cockspur.

It seems hardly conceivable that so singular a product as ergot should have escaped the notice of ancient writers;

but no distinct reference to it is to be found in their works on medicine. It is supposed to be the *ignis sacer* or *ignis sanctii Antonii*, of the Middle Ages. It was employed by women to promote labor-pains long before its properties were generally recognized by the medical profession. It was originally given in the crude form, an odd number of grains being administered. In the middle of the sixteenth century, Loncier, of Frankfort, called attention prominently to its properties and uses. It was not until 1836 that it found a place in the London Pharmacopœia.

Ergot is imported from France, Germany, and America, where it is obtained almost exclusively from rye, but the same fungus flourishes on grasses belonging to many other genera and species. Ergot, itself, is liable to be infested by an acarus, which often destroys the whole interior, leaving only the shell filled with its excrement.

It is advisable not to use ergot which has been kept for more than two years.

ACTIVE PRINCIPLES.—The composition of ergot is very complex, and the active principle on which its most important action (that of causing contraction of the uterus) depends, has not been satisfactorily isolated. The following substances have at one time or another been described as active principles :

Ergotin.—This is official, and is commonly known as "Bonjean's ergotin." It is not an alkaloid or glucoside, but a purified extract of ergot, of dark-brown color, and having an odor like roast beef. It is sometimes desiccated, and is sold in the form of brittle lumps.

Another substance, not official, is sold under the name of "Wigger's ergotin"—a resinous, reddish substance, which is said to possess ten times the activity of ergot. Köhler examined both varieties of ergotin, and found that Bonjean's contained all the constituents insoluble in water, whilst Wigger's contained all the soluble ones, neither of them representing all the properties of ergot.

Ergotinine.—This is a substance described by Tanret.

It is a whitish alkaloid, usually amorphous, but sometimes met with in a crystalline form. It is insoluble in water; but dissolves in alcohol, ether, chloroform, and acids. It is very unstable, and decomposes rapidly. It is best administered hypodermically, dissolved in lactic acid. There is reason to believe that it is physiologically inactive, and that any therapeutical action it may possess is due to the admixture of other principles.

Ecbolin.—This is a brown, amorphous, bitter substance, often described as an alkaloid. It is probably not a pure substance, and there is no evidence that it is active.

Ergotinic acid.—This is a glucoside, and is probably the most active constituent of Bonjean's ergotin, and of the dialyzed ergotin of Wernich. It gives rise to ascending paralysis of the spinal cord and brain, both in frogs and mammals, with loss of voluntary motion, paralysis of the vaso-motor centre, and fall of blood-pressure. It does not increase uterine contraction. It is active only when introduced hypodermically, and, if administered by the stomach, is decomposed by the digestive ferments, and split up into glucose and an inert base. It is probably useful as a hæmostatic.

Sclerotinic acid is simply an impure form of ergotinic acid. It is given hypodermically in doses of from a half to three-quarters of a grain.

Sphacelinic acid.—This is the substance which gives rise to the gangrene sometimes following the use of ergotized grain. It produces tonic contraction of the uterus.

Cornutine.—This is an alkaloid which, in pregnant animals, produces clonic contraction of the uterus. Like sphacelinic acid, it can be extracted only by alcohol, and is not contained in watery-extracts of ergot.

In addition to these principles, ergot contains about thirty-five per cent. of oil, a peculiar sugar known as mykose, and two coloring matters—scleroxanthin and scleroerythrin.

It is probable that sphacelinic acid and cornutine are the principles which act chiefly on the uterus; but as, at present, they can hardly be regarded as commercial products, it is safer to use a fluid-extract of ergot.

General Action.—Administered in large doses to the lower animals, ergot induces profuse salivation, vomiting, dilatation of the pupils, hurried breathing, a frequent pulse, trembling of the limbs, a staggering gait, paraplegia, thirst, convulsions, and finally death. Administered to man, the toxic action is slight. Doses of an ounce of the fluid-extract produce no symptoms, unless the patient happens to be pregnant.

Special Actions.—The chief action of ergot is exerted on involuntary muscular tissue, in which respect it is allied to belladonna. The form of muscular tissue chiefly affected is that composing the uterus, especially the uterus of parturient women. The spasms caused by the drug are not identical with labor-pains, but are more frequent and more prolonged. Large doses induce tetanic spasm of the whole organ. It is probable that ergot acts directly on the involuntary muscle itself; but it is conceivable that it may act in part on the uterine nerve-centre in the spinal cord. It is doubtful whether ergot ever acts as an abortifacient. Evidence shows that it aids the expulsion of the contents of the uterus when labor has commenced, but is powerless to start the process. It is an ecbolic, but probably not an abortifacient.

Ergot produces spasm of the blood-vessels, acting both on the arteries and the veins. When the web of a frog's foot is placed under the microscope and ergot is injected, the vessels, both arterial and venous, are seen to undergo contraction. When the arteries of the thigh, back, or pia mater of a rabbit are exposed, and ergot is administered, there is a notable diminution in their calibre. Wave-like, peristaltic spasms are often seen in the ergotized vessels so treated. The contraction of the retinal vessels, in man, can be seen with an ophthalmoscope after the administration of ergot. These facts seem to show that ergot contracts the blood-vessels. Supposing this to be the case, one would expect a marked rise in blood-pressure after the injection of ergot; curiously enough, however, the *primary* effect is to produce a marked fall in blood-pressure. This is probably due to a direct action of the drug on the cardiac muscle when the injection is made into a jugular vein. As confirmatory of this theory, it is asserted that the fall does not occur when the drug is introduced, not directly into the vein, but hypodermically. The *ultimate* effect of ergot, by whatever channel it is introduced, is to raise the blood pressure; this is undoubtedly due, to a very great extent, to the action of the drug on the medulla.

Ergot acts on the involuntary muscular tissue of the intestine and increases peristalsis. Such exaggerated movement after the injection of ergot is very noticeable *post-mortem*, and may also be observed through the abdominal walls during life.

The quantity of urine secreted under the influence of ergot is increased in consequence of the rise of blood-pressure, and there is also evidence to show that the contractile power of the bladder is intensified.

Voluntary muscles are unaffected, and the drug exerts no action on motor-nerves.

In the lower animals the spinal cord is paralyzed, and death usually ensues from paralysis of the respiratory-centre.

In its action on the uterus ergot is allied to gossypium and ustilago. It is probable that the last-named substance contains some of the same active principles as ergot.

The prolonged use of ergotized bread, in certain districts, is reputed to give rise to epidemics of dry-gangrene. This disease has seldom or never been observed in England, but was at one time common in some parts of France, where rye formed the principal food of the inhabitants. It occurred only after rainy seasons, when the grain was largely affected by ergot. Attention was first called to the subject in 1676, by Mr. Dodart. The patients were usually affected first in the lower extremities, and the gangrene was attended with but little fever, inflammation, or pain. The disease appeared in Switzerland in 1709 and 1716, and many people were afflicted with swellings of the feet, legs, and arms, which degenerated into a gangrene that penetrated to the bone, and ultimately resulted in the separation of the limb. Dr. Wollaston recorded several cases in one family in which gangrene was produced by partaking of damaged wheat. The mother lost her right foot at the ankle; a daughter, aged fifteen, was deprived of hers just below the knee ; other members of the family lost fingers and toes, besides other more or less important appendages.

It is possible that the gangrene produced by ergot may be due to sphacelinic acid, which causes spasmodic contraction of the blood-vessels. The gangrene produced artificially in fowls is due to permanent occlusion of the smaller arteries by a hyaline substance, formed while the arteries remain spasmodically contracted. In some cases of gangrene, sclerosis has been noted in the postero-lateral columns of the cord. To what extent gangrene is the result of eating ergotized bread, and how much of it is due to the absence of proper food, it is difficult to determine ; ergot, administered to people living under the ordinary conditions of life, never produces gangrene. In a case of diabetes insipidus, I gave half-drachm doses of the fluid-extract every three hours, for months together, with marked benefit, and without the production of any symptoms of gangrene.[1]

THERAPEUTICS.—Ergot is used successfully in post-partum bleeding, hæmoptysis, and in almost all forms of bleeding. It must be given in large doses, and no hesitation need be felt in ordering a couple of drachms or more of good fluid-extract of ergot every hour, or oftener, in such cases. When it is undesirable to give ergot by mouth, ergotine may be injected hypodermically.

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[1] British Medical Journal, 1875, vol. ii.

Large doses of ergot are useful in cases of subinvolution of the uterus, in menorrhagia, and especially, I think, in the treatment of uterine fibro-myoma.

In diabetes insipidus, large doses of ergot may be given with every reasonable prospect of effecting a permanent cure.

[PREPARATIONS.—Extractum Ergotæ Fluidum; Vinum Ergotæ.]

DRUGS OF ANIMAL ORIGIN

COD-LIVER OIL

Cod-liver oil, oleum morrhuæ, or oleum jecoris aselli, is the oil extracted from the fresh liver of the cod (*Gadus Morrhua*) and other species of *Gadus*. Although we have no record fixing the exact date when cod-liver oil was first used, we have reason to believe that it is a remedy of very considerable antiquity. The Greenlanders, Laplanders, and Esquimaux were acquainted with its virtues long before they came in contact with civilization.

It is chiefly to the writings of Dr. Hughes Bennett ("Treatise on the Oleum Jecoris Aselli," 1841), and of Dr. C. J. B. Williams (1849), that we are indebted for the introduction of cod-liver oil into modern medicine. The oil employed by them was a very crude product, and it was not until 1853 that Peter Möller introduced his method of obtaining the oil by a process of steam-extraction.

Cod-liver oil is procured from Norway and Newfoundland [and the coast of New England]. In Norway, most of the codfish are taken in the neighborhood of the Loffoden islands, within the arctic circle, the annual yield being somewhere about 24,500,000 fish. Among the countries which produce the oil, Norway naturally takes the first place. This is due to the fact that the Norwegian fisheries are carried on under circumstances much more favorable than are met with elsewhere. The steam-process of extraction requires a supply of absolutely fresh livers, and the fishing grounds of Loffoden and Romsdal are situated so near the coast, that the boats leaving in the morning are back again, with their catch of fish, in the course of a few hours. Off the Banks of Newfoundland, fleets of smacks are employed in collecting the fish, which are taken to an attendant steamer, where the process of extraction is carried on.

There is no test for the purity of cod-liver oil. Leaving adulteration out of the question, and assuming a genuine specimen of oil from the *Gadus Morrhua*, the only criteria on which reliance can be placed are color, taste, and smell.

The best kinds of oil are, as nearly as possible, colorless and tasteless. Some people prefer the coarse, brown oil; but they are decidedly in the minority, and, practically, it is found that the paler the oil the better it is adapted for medicinal purposes. The darker varieties have the same composition; but they contain more empyreumatic matter, and are less agreeable to the taste. Nowadays no one even thinks of prescribing the brown oil. It is simply an abomination, and it is almost inconceivable that any patient could be found willing to take it. Some people seem to delight in nasty medicines; but there is no advantage in taking this nauseous substance.

Cod-liver oil is a food rather than a medicine, and much of its utility is due to its ready absorption and quick assimilation. That it is more readily absorbed than olive-oil, can be demonstrated by a very simple experiment: If two loops of intestine are filled, one with cod-liver oil and the other with olive-oil, and then replaced in the abdomen, the one containing cod-liver oil soon becomes less distended than the other.

Its digestion is easily effected, because a portion of the fat is in the form of fatty acids. When these reach the intestines they become at once saponified without the cooperation of the pancreatic ferment, and they emulsify the remaining fat and favor its absorption. Its ready absorption may also be demonstrated by a very simple experiment: In capillary tubes, moistened with water, fats rise very little, but when the tubes are moistened with bile the fats rise readily. Fats pass with difficulty through a moist animal membrane; but if the membrane is moistened with bile, they pass through readily.

Cod-liver oil is not absorbed from the stomach, but promotes the conversion of starch into sugar. After absorption from the intestines, the chief portion of the fat passes into the lacteals, and a little into the veins, to be conveyed to the liver, there to be converted into cholic acid. The cholic acid, uniting with the soda which is set free when the hydrochloric acid of gastric juice is poured into the intestines, forms a kind of soap, consisting of taurocholate and glycocholate of glycerin. These, again, find their way into the intestines, where the base unites with the acid of the gastric juice from which it has been separated.

The influence of cod-liver oil on the secretion of bile varies according to circumstances, for if taken on an empty stomach it lessens biliary secretion, while if taken with or after food it increases it.

Cod-liver oil, after passing into the blood-vessels, influences the nutrition of the corpuscles, contributing to their formation and development. It is found that, in health, cod-liver oil causes a decided increase in the number of red corpuscles and, also, a slight increase in the number of white ones. In virtue of its property of stimulating nutrition, cod liver oil improves all the functions of the body, although it has no specific action on any particular organ.

There seems to be very little doubt that animal fats, such as this, exert a much more powerful influence on the system than do vegetable fats, and the superiority of the fat obtained from the liver is supposed to be due to its more ready absorption. Whether the liver-fat of the cod possesses any particular advantage over fat derived from the liver of other animals may be open to question. It is not absorbed, however, in unlimited quantities, and, if given in excessive doses, produces nausea and diarrhœa, and is eliminated with the fæces. As a rule, fats are consumed in the body, the quantity eliminated, either with the fæces or the urine, being very small.

Cod-liver oil is of such inestimable value, not only in phthisis but in all wasting diseases, and it is so universally employed, that a mere reference to its use as a fattening agent is all that is necessary. It is thus useful in the chronic diseases of children arising from malnutrition; in the various manifestations of scrofula, and is just as useful for old people as it is for children.

The points in the administration of cod-liver oil as a therapeutic agent are:

The oil should be of pale color, and practically tasteless and odorless. The initial dose should be a teaspoonful, and the maximum dose should not exceed a tablespoonful. It should be given immediately after food, so as to form, practically, a portion of the meal.

The oil may be given by itself; with a pinch of salt; floating in the froth of stout, or on the top of a mixture such as the gentian and soda mixture. The following prescriptions for "oil sauce," designed by the late C. J. B. Williams, are well known:

Diluted Phosphoric Acid,	℥ ss.
Solution of Strychnine,	ʒ j.
Tincture of Orange-peel,	℥ j.
Syrup of Ginger,	ʒ j.
Compound Infusion of Orange-peel, to	℥ viij.

The dose is one tablespoonful.

Diluted Phosphoric Acid,	ʒ ss.
Hypophosphite of Sodium,	ʒ ij.
Tincture of Quinine,	℥ jss.
Glycerin,	ʒ j.
Compound Infusion of Orange, to	℥ viij.

Dose, one tablespoonful.

Diluted Nitric Acid,	ʒ iij.
Tincture of Calumba,	℥ j.
Syrup of Ginger,	℥ j.
Compound Infusion of Orange,	to ℥ viij.

Dose, one tablespoonful.

On theoretical grounds, the custom of giving cod-liver oil with an acid mixture is open to criticism.

Though it is sometimes given in the form of an emulsion, such preparations are, as a rule, not palatable, and have no advantage over the pure oil. The substances commonly employed as emulsifying agents are eggs, dextrin, extract of malt, quillaia, condensed milk, and various gums. A fairly good emulsion may be made by rubbing together cod-liver oil, yolk of egg, powdered tragacanth, elixir of saccharin, spirit of chloroform, essential oil of almond, and water. The success of an emulsion depends less on the proportions of its ingredients than on the amount of time devoted to amalgamating them.

CANTHARIDES

The *Cantharis vesicatoria*, blister-beetle or Spanish fly, is indigenous to Southern and Central Europe, and is collected in Russia and Sicily, but chiefly in Hungary. The "flies" are sometimes met with in England, but very rarely. During the months of May and June they swarm on the ash, privet, lilac, and elder. They are collected usually in the early morning, or in the evening, when they are drowsy, by spreading cloths under the trees which are then shaken or beaten with long poles. The beaters wear masks, and their hands are protected with gloves. The insects are killed by dipping them for a moment in boiling vinegar, after which they are dried on hurdles covered with sheets of paper. They are preserved in well-stoppered bottles, and a few drops of strong acetic acid are usually added, to prevent the ravages of mites which attack them freely. The beetles have a peculiar, urinous odor, and a burning taste. The finely-powdered cantharides is of a grayish-brown color, and is mixed with minute, shining, green particles—fragments of the elytra or wing-cases.

The ACTIVE PRINCIPLE of cantharides is a crystalline substance known as cantharidin. It is usually in flat, glistening, rectangular prisms, which are soluble in glacial acetic acid, in chloroform, and in oils; but insoluble in water, and only very slightly soluble in cold alcohol.

ACTION.—When strong preparations of cantharides are applied to the skin, they excite, in a variable time (depending on the strength of the application), tingling, smarting, and a sense of heat; the papillæ becoming reddened and elongated, and on these papular elevations minute vesicles are formed, gradually enlarge, and, by lateral extension, coalesce so as to form blebs of various sizes filled with an albuminous fluid. When the application is prolonged, suppuration, ulceration, and even sloughing may ensue. These effects of cantharides differ from those of mustard chiefly in being less rapid but more severe.

Tincture of cantharides, taken internally, produces an unpleasant, burning taste in the mouth, and may give rise to inflammation and vesication of the mucous membrane. The effect on the œsophagus and stomach is similar. Inflammation is excited, and the patient suffers from diarrhœa and vomiting. There is difficulty in swallowing, and the stools and vomited matter are mixed with blood and mucus. Peritonitis is excited, the temperature is elevated, and the pulse is quickened. From the stomach, the active principle is absorbed into the blood, and, in the process of elimination, gives rise to irritation of the urinary passages and organs of generation. The most noticeable symptoms are pain in the loins; a burning sensation referred to the bladder and urethra; irritation of the glans penis, and sexual excitement. The patient suffers from painful and persistent erections, difficulty of micturition, or suppression of the urine. The urine contains albumin and, not infrequently, blood. The inflammation produced by cantharides begins in the glomeruli and not in the straight tubes. The first condition of the kidneys noticed after the administration of cantharides is extravasation of leucocytes into the glomeruli, and an exudation of a fibrous matrix. This is followed by filling of the glomeruli and the proximate tubules with a granular fluid, after which comes swelling of the cells of the capsule. Next in order, swelling of the cells of the collecting tubes and of the whole urinary tubule is observed; and, in the last stage, multiplication of the cells of the straight collecting-tubes, which are thrown off so that their lumen becomes filled with exuded cells.

When the kidneys are diseased, cantharides must be employed cautiously, or it may not be eliminated by those organs. In young people, and those who are debilitated by disease, it should be used as a vesicant with the greatest caution, as, from low vitality of the tissues, it is apt to produce sloughing and gangrene. The contraction of distant capillaries is not infrequently followed by a paretic distension, and by lowering of trophic change, analogous to the condition which gives rise to ulceration of the duodenum after severe burns of the surface.

THERAPEUTICS.—Externally, cantharides is of the greatest value in the form of "flying blisters." Half a dozen pieces of cantharides plaster, the size of half a crown, should be applied to the chest and back in cases of pleurisy and pleurodynia, taking care to remove them to some other part before they produce vesication. This mode of treatment acts as a powerful stimulant in cases of fever in which a typhoidal condition is the chief danger.

When larger blisters are applied, and a bleb is formed, it is better to cover it with cotton wool, and allow the serum to be absorbed, rather than to cut it and evacuate the fluid. Blistering-fluid is a very uncertain preparation, and, even when the skin has been previously poulticed or fomented, often fails to raise a blister.

Preparations of cantharides are largely employed as local applications for promoting the growth of hair, for whic the following is a useful lotion :

Tincture of Cantharides,	ʒ vj.
Tincture of Nux-vomica,	ʒ iij.
Distilled Vinegar,	℥ ijss.
Tincture of Capsicum,	ʒ j.
Spirit of Rosemary,	ʒ ij.
Elderflower-water,	℥ j.
Rose-water,	to ℥ vj.

Large doses of cantharides are useful in impotence, especially in the impotence of elderly men. The following prescription usually exercises a beneficial effect :

Tincture of Cantharides,	ʒ ijss.
Tincture of Chloride of Iron,	ʒ ij.
Tincture of Nux-vomica,	ʒ jss
Diluted Phosphoric Acid,	℥ ss.
Glycerin,	iij.
Elixir of Orange,	j.
Water,	to ℥ viij .

An eighth part is to be taken three times a day, after meals. It is undoubtedly useful, but accessory treatment will be found desirable.

Some people, in these cases, place more reliance on a pill containing two grains of extract of damiana, a quarter of a grain of nux-vomica, and a hundredth of a grain of phosphorus ; but the mixture rarely fails.

As a local application, a lotion containing half a drachm of tincture of cantharides in six ounces of water, scented with eau-de-Cologne or elderflower-water, is frequently recommended by irregular practitioners.

Small doses of cantharides may be relied upon to cure the slight incontinence of urine which, with women, is frequently associated with paroxysmal cough. Half a drachm of tincture of cantharides is prescribed with four ounces of water, and of this a teaspoonful is taken hourly. It rarely fails to effect a cure in twenty-four hours.

[PREPARATIONS.—Ceratum Cantharidis ; Collodium Cantharidatum ; Tinctura Cantharidis.]

PHARMACOLOGICAL GROUPS

PHARMACOLOGICAL GROUPS

Exhilarants

Alcohol
Ether
Chloroform
Tea
Opium (in small doses)
Coffee—Caffeine
Coca—Cocaine

Deliriants

Cannabis Indica—Cannabin
Belladonna—Atropine—Homatropine
Hyoscyamus—Hyoscyamine
Stramonium
Alcohol
Ether
Chloroform
Turpentine
Nitrous oxide

Hypnotics or Soporifics

Opium—Morphine—Codeine
Paraldehyde
Chloral hydrate
Sulphonal
Alcohol
Butyl-chloral-hydrate

Spinal Stimulants

Nux-vomica—Strychnine—Brucine—Ignatia
Thebaine
Cannabis indica

Spinal Sedatives

Bromides
Chloral hydrate
Butyl-chloral-hydrate
Paraldehyde
Physostigma—Physostigmine

Cerebral Sedatives

Bromides
Hop
Beer
(Brandy-and-water, hot)
Lettuce
Alcohol

Cerebral Convulsants

Picrotoxin
Camphor

Paralyzers of Motor Nerves

Curare—Curarine
Conium—Coniine
Ethyl-strychnine
Ethyl-nicotine
Methyl-nicotine
Methyl-strychnine
Methyl-atropine

Many other substitution-compounds of alkaloids.

Local Anæsthetics

Ether
Cold
Cocaine
Carbolic acid
Menthol
Aconitine
Thymol
Volatile oils

General Anæsthetics

Chloroform
Ether
Nitrous oxide
Tetrachloride of carbon
Ethidene
"A. C. E." mixture

Diaphoretics

Acetate of ammonium
Muscarine
Picrotoxin
Dover's powder
Alcohol
Jaborandi—Pilocarpine
Ether

Anhydrotics

Belladonna—Atropine—Homatropine
Hyoscyamus—Hyoscyamine
Stramonium
Picrotoxin (small doses)
Pilocarpine (small doses)
Agaricus—Agaricine
Jaborine
Dover's powder (small doses)

Mydriatics

Belladonna—Atropine—Homatropine
Hyoscyamus—Hyoscyamine
Cocaine
Gelsemine

Cocaine is used as an anæsthetic for the eye, and, when mydriasis is objectionable, is combined with eserine

Myotics

Physostigmine
Pilocarpine
Opium—Morphine

Cardiac Tonics

Digitalis—Digitalin—Digitaleïn—Digitoxin
Strophanthus—Strophanthin
Convallaria—Convallamarin
Casca—Erythrophlœin
Adonis—Adonidin

Cardiac Stimulants

Ammonia
Spirit of chloroform
Ether
Brandy—Whiskey—Champagne—Cologne-water

Cardiac Depressants

Aconite
Veratrum viride
Tobacco

Vascular Dilators

Nitroglycerin
Nitrite of amyl
Nitrous ether
Alcohol
Ether

Vascular Contractors

Belladonna
Ergot
Digitalis

Pulmonary Stimulants

Antimonial wine
Ipecacuanha
Apomorphine (by mouth)
Terebene
Turpentine
Tar
Carbonate of ammonium
Chloride of ammonium
Iodide of potassium

Pulmonary Sedatives

Conium—Coniine
Belladonna
Hyoscyamus
Stramonium
Hydrocyanic acid
Tobacco

Special Respiratory Stimulants

Acting on nerve-centres controlling respiratory movements

Atropine
Strychnine
Cocaine

Salivators

Muscarine
Jaborandi—Pilocarpine
Picrotoxin
Mercury

Mouth Dryers

Belladonna—Atropine—Homatropine
Jaborine
Stramonium
Hyoscyamus—Hyoscyamine

Stomachic Tonics

Quinine
Gentian
Calumba
Quassia
Nux-vomica—Strychnine
Chiretta
Cusparia

Diminishers of Secretion

Acids
Opium
Belladonna

Stomachic Sedatives

Bismuth
Hydrocyanic acid
Oxalate of cerium
Opium

Purgatives

Sulphur
Tamarinds
Figs
Honey
Manna
Castor-oil
Senna
Magnesia
Saline purgatives
Aloes—Aloïn
Elaterium—Elaterin
Colocynth
Scammony
Jalap
Blue-pill
Croton-oil

Emetics

Apomorphine (hypodermically)

Sulphate of zinc
Ipecacuanha
Mustard
Common salt
Sulphate of copper
Tartrated antimony

Cholagogues

Blue-pill
Podophyllin
Hydrastis—Hydrastin
Euonymin
Iridin

Anthelmintics

Male fern
Santonica—Santonin
Pomegranate root
Kamala
Koosso
Areca nut
Turpentine
Infusion of quassia (enema)
Solution of salt (enema)
Solution of chloride of iron (enema)

Diuretics

Digitalis
Strophanthus
Broom
Caffeine
Juniper
Acetate of ammonium
Gin
Potash salts
Copaiba

Producers of Hæmaturia and Albuminuria

Cantharides
Turpentine
Carbolic acid

Producers of Glycosuria

Nitrite of amyl
Ether
Carbonic oxide
Morphine (large doses)
Chloroform

Vesical and Urethral Alteratives

Copaiba
Cubebs
Benzoin
Sandal-wood oil
Eucalyptus
Terebene

Santonin, rhubarb, carbolic acid, and resorcin color the urine; turpentine, eucalyptus, and terebene give it a characteristic odor.

Aphrodisiacs

Nux-vomica—Strychnine
Cantharides
Tincture of chloride of iron (large doses)
Damiana
Phosphorus

ANAPHRODISIACS

Bromides
Tobacco (?)

EMMENAGOGUES

Permanganate of potassium
Binoxide of manganese
Ergot
Senecio—Senecin
Borax

ECBOLICS

Ergot
Ustilago
Cotton-root bark
Savin

ABORTIFACIENTS

Ergot—Ergotin
Cotton-root bark
Savin
Colocynth
Pennyroyal
Parsley—Apiol
Green tea

FORMULAS

FORMULAS

MIXTURES

QUININE

I

Sulphate of quinine, two grains
Diluted sulphuric acid, two minims
Tincture of orange, one drachm
Water, to an ounce
To be taken three times a day, before meals

II

(Strong)

Sulphate of quinine, five grains
Diluted sulphuric acid, five minims
Tincture of gelsemium, ten minims
Spirit of chloroform, fifteen minims
Cinnamon-water, to an ounce
Useful in supraorbital neuralgia

QUININE AND IRON

Sulphate of quinine, two grains
Sulphate of iron, three grains
Diluted sulphuric acid, two minims
Tincture of capsicum, one minim
Chloroform-water, to an ounce
To be taken thrice daily, after meals

IRON

I

Tincture of chloride of iron, fifteen minims
Spirit of chloroform, fifteen minims
Glycerin, fifteen minims
Water, to an ounce
To be taken three times a day, after meals

II

(*Aperient*)

Sulphate of iron, two grains
Sulphate of magnesium, half a drachm
Diluted sulphuric acid, five minims
Tincture of capsicum, two minims
Peppermint water, to an ounce
To be taken three times a day, after meals

III

(*Saline*)

Citrate of potassium, half a drachm
Tincture of chloride of iron, fifteen minims
Spirit of chloroform, fifteen minims
Water, to an ounce
To be taken three times a day, after meals

ACETATE OF AMMONIUM AND IRON

Solution of acetate of ammonium, two drachms
Tincture of chloride of iron, ten minims
Spirit of ether, ten minims
Diluted acetic acid, ten minims
Water, to an ounce

IRON AND DIGITALIS

Tincture of chloride of iron, fifteen minims
Infusion of digitalis, one drachm
Diluted phosphoric acid, fifteen minims
Water, to an ounce
To be taken three times a day, after meals

IRON (*Effervescent*)

I

Citrate of iron and ammonium, ten grains
Carbonate of ammonium, five grains
Bicarbonate of potassium, fifteen grains
Syrup of ginger, half a drachm,
Water, to an ounce and a half

With a tablespoonful of lemon juice, during effervescence

II

Citrate of iron and quinine, ten grains
Sulphate of quinine, two grains
Citric acid, seventeen grains
Water, to an ounce

To be taken thrice daily, during effervescence, with :

Bicarbonate of sodium, twenty grains
Water, half an ounce

III

Citrate of iron and quinine, ten grains
Citric acid, seventeen grains
Water, to half an ounce

To be taken during effervescence, with :

Bicarbonate of potassium, twenty-five grains
Spirit of chloroform, fifteen minims
Water, to an ounce

IODIDE OF SODIUM

Iodide of sodium, fifteen grains
Water, half an ounce

Given in black coffee, after dinner, in cases of asthma.

IODIDE OF POTASSIUM

Iodide of potassium, five grains
Tincture of wild cherry, half a drachm
Chloroform-water, to an ounce

To be taken three times a day, after meals[1]

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[1] [Action of the iodides is increased by abundant dilution.]

Bromide of Potassium

Bromide of potassium, twenty grains
Spirit of chloroform, fifteen minims
Syrup of orange-flower, half a drachm
Water, to an ounce

To be taken three times a day, after meals, with a
extra dose at bedtime

Gentian and Soda

Bicarbonate of sodium, fifteen grains
Spirit of chloroform, fifteen minims
Tincture of capsicum, one minim
Syrup of orange, half a drachm
Compound tincture of gentian, half a drachm
Compound infusion of gentian, to an ounce

To be taken three times a day, before meals

Calumba and Acid

Diluted hydrochloric acid, ten minims
Tincture of nux-vomica, five minims
Glycerin, fifteen minims
Tincture of calumba, a drachm
Infusion of calumba, to an ounce

To be taken three times a day, after meals

Diuretic

I

Acid tartrate of potassium, forty grains
Tincture of digitalis, ten minims
Spirit of nitrous ether, half a drachm
Water, to an ounce

II

Acetate of potassium, two grains
Tincture of strophanthus, ten minims
Compound spirit of ether, fifteen minims
Spirit of juniper, fifteen minims
Decoction of broom, to an ounce

To be taken three times a day, after meals

Expectorant

I

Carbonate of ammonium, five grains
Wine of ipecacuanha, ten minims
Spirit of chloroform, fifteen minims
Compound spirit of ether, ten minims
Syrup of tar, two drachms
Syrup of wild-cherry, half a drachm
Water, to an ounce

II

Chloride of ammonium, ten grains
Carbonate of ammonium, five grains
Iodide of potassium, three grains
Spirit of ether, fifteen minims
Fluid-extract of liquorice, one drachm
Water, to an ounce

To be taken every four hours

III

Solution of apomorphine,[1] ten minims
Diluted nitrohydrochloric acid, five minims
Tincture of wild-cherry, twenty minims
Syrup of wild-cherry, twenty minims
Water, to an ounce

May be taken three times a day, as an expectorant

IV

Hydrochlorate of apomorphine, one twenty-fifth of a grain
Hydrochlorate of morphine, one thirty-third of a grain
Diluted hydrochloric acid, two minims
Glycerin, ten minims
Water, to a drachm

May be taken frequently, as an expectorant

[Br. Pharm. solution—50 per cent. of the hydrochlorate.]

V

Solution of hydrochlorate of morphine,[1] three minims
Spirit of chloroform, three minims
Syrup of lemon, fifteen minims
Water, to a drachm

To be taken frequently, when cough is troublesome

VI

Codeine, one-eighth of a grain
Spirit of chloroform, three minims
Syrup of wild-cherry, ten minims
Water, to a drachm

VII

Creasote, one minim
Glycerin, twenty minims
Water, to half an ounce

VIII

Syrup of squill
Syrup of poppy
Syrup of lemon equal parts
Syrup of Tolu

The dose is a teaspoonful, to be taken frequently

ACETATE OF LEAD

Acetate of lead, five grains
Solution of acetate of morphine,[2] ten minims
Diluted acetic acid, fifteen minims
Cinnamon-water, to an ounce

GALLIC ACID

Gallic acid, ten grains
Diluted sulphuric acid, ten minims
Tincture of capsicum, one minim
Acid infusion of rose, to an ounce

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[1] [Br. Pharmacopœia—1 per cent.]
[2] [Br. Pharm. solution—1 per cent.]

TURPENTINE

Oil of turpentine, fifteen minims
Mucilage of acacia, one drachm
Spirit of lavender, half a drachm
Pimento-water,[1] to an ounce

COLCHICUM

Wine of colchicum, fifteen minims
Iodide of sodium, five grains
Spirit of chloroform, fifteen minims
Compound spirit of ether, five minims
Syrup of orange-flower, half a drachm
Water, to an ounce

To be taken three times a day; is useful in chronic gout

SENECIO

Tincture of senecio, half a drachm
Syrup of lemon, fifteen minims
Spirit of chloroform, ten minims
Water, to an ounce

For amenorrhœa; to be taken four times a day

AMBER

Oil of amber, ten minims
Powdered gum acacia, one drachm
Syrup of orange-flower, two drachms
Oil of anise, three minims
Water, to an ounce

Useful in chronic bronchitis, and also in whooping cough

TERPIN HYDRATE

Terpin hydrate, ten grains
Simple elixir, one drachm
Water, to an ounce

Terpene is so largely used in France in the treatment of bronchial catarrh, that it is somewhat surprising that it is not more generally employed. For diabetic patients, the elixir should be sweetened with saccharin in place of sugar

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[1] [An aromatic water, official in Great Britain.]

DRAUGHTS

SEDATIVE

Bromide of potassium, fifteen grains
Bromide of sodium, fifteen grains
Syrup of chloral hydrate, one drachm
Syrup of Tolu, one drachm
Water, to an ounce

To be taken at bedtime, for sleeplessness

"PICK-ME-UP"

Bromide of potassium, fifteen grains
Spirit of chloroform, twenty minims
Compound tincture of gentian, ten minims
Compound tincture of cardamom, ten minims
Aromatic spirit of ammonia, ten minims
Simple elixir, half a drachm
Peppermint-water, to an ounce

EXALGINE

I

Exalgine, four grains
Essence of peppermint, five minims
Syrup of orange-flower, half a drachm
Linden-water, to an ounce

For the relief of neuralgia

II

Exalgine, four grains
Tincture of wild-cherry, twenty minims
Glycerin, fifteen minims
Water, to an ounce

ANTIPYRIN

Phenazone, five grains
Elixir of orange, one drachm
Water, to an ounce

For headache

MALE FERN

Fluid extract of male fern, a drachm and a half
Syrup of ginger, one drachm
Tincture of quillaia, half a drachm
Water, an ounce and a half

To be taken while fasting, after efficient purgation by castor-oil

DROPS

ANTISPASMODIC

I

Sulphuric ether, one ounce
Tincture of opium, one ounce
Chloroform, one ounce
Alcohol, one ounce

The dose is ten drops in water, for flatulence

II

Oil of cajuput, one drachm
Oil of clove, one drachm
Oil of peppermint, one drachm
Alcohol, to two ounces

Ten drops on sugar, occasionally, for flatulence

III

Thymol, two grains
Camphor, five grains
Compound tincture of lavender, half an ounce
Tincture of myrrh, half an ounce
Alcohol, to two ounces

From five to ten drops to be taken on sugar

BENZOL

Benzol,[1] three drachms
Oil of peppermint, one drachm
Olive-oil, two ounces
Ten drops on sugar, every four hours, for bronchitis

EYE-DROPS

ATROPINE

Sulphate of atropine, one grain
Water, to an ounce

HOMATROPINE

Hydrobromate of homatropine, two grains
Water, to an ounce

ESERINE

Sulphate of eserine, two grains
Water, to an ounce

PILOCARPINE

Nitrate of pilocarpine, two grains
Water, to an ounce

HOMATROPINE AND COCAINE

Hydrobromate of homatropine, two grains
Hydrochlorate of cocaine, ten grains
Water, to an ounce

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[1] [Phenyl Hydride.]

PILLS

ALTERATIVE

Compound extract of colocynth, one grain
Blue-pill, one grain
Powdered ipecacuanha, a quarter of a grain
Extract of henbane, one grain

One pill at bedtime

APERIENT

Compound colocynth-pill, two grains
Blue-pill, a grain and a half
Powdered ipecacuanha, one-third of a grain
Extract of henbane, one grain

Much the same as the preceding pill, but stronger

APERIENT (*Strong*)

Socotrine aloes, two grains
Colocynth, one grain
Gamboge, one grain
Oil of cassia, half a minim
Compound decoction of aloes, enough to make a pill

This is considerably stronger than the foregoing

CROTON-OIL

Croton-oil, half a minim
Extract of colocynth, two and a half grains
Gingerin, one-eighth of a grain
Hard soap, two grains

This is a still stronger pill

DIURETIC

Powdered digitalis, half a grain
Squill, one grain
Blue-pill, three grains

One pill at bedtime

Astringent

Sulphate of copper, a quarter of a grain
Extract of opium, a quarter of a grain
Confection of rose, enough to make a pill

Useful in hæmorrhage from the intestine

Expectorant

Powdered ipecacuanha, half a grain
Guaiacum, one grain
Opium, half a grain
Compound pill of squill,[1] two grains

Lozenge-Pill

Hydrochlorate of morphine, one thirty-sixth of a grain
Extract of liquorice, three grains
Compound powder of tragacanth,[2] five grains

To be made into a "lozenge-pill"

This will be useful in relieving the cough of phthisis. One should be sucked, slowly, several times a day

Morphine and Conium

Hydrochlorate of morphine, one-eighth of a grain
Extract of conium, two grains
Powdered ipecacuanha, half a grain

Usually taken at bedtime

Codeine

Codeine, half a grain
Powdered liquorice root, two grains
Treacle, enough to form a pill mass

Useful in coughs

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[1] [Br. Pharm.]

[2] [Br. Pharm.—Contains, also, gum acacia, starch and sugar, and is used as a vehicle.]

Tar

Tar (*pix liquida*), two grains
Lycopodium, one grain

Two every four hours

Valerianate of Zinc

Valerianate of zinc, one grain
Compound pill of assafœtida,[1] two grains
Confection of rose, one grain

Pill of Three Sulphates

Sulphate of quinine, one grain
Sulphate of iron, one grain
Sulphate of zinc, one grain
Extract of gentian, two grains

Lithia and Sulphur

Benzoate of lithium, three grains
Precipitated sulphur, two grains
Salicylate of quinine, half a grain

For chronic gout

Picrotoxin

Picrotoxin, one-sixtieth of a grain
Sugar of milk
Glycerin of tragacanth } of each, enough

Make a pilule

To be taken at bedtime, to check the night-sweating of phthisis; to be repeated if necessary

Musk

Musk, two grains
Sugar of milk, enough to make twelve pills

One or two, three times a day, as a nervine stimulant in cases of hysteria attended with flatulence. Musk costs half a crown a grain[2]

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[1] [Br. Pharm.—Has, also, galbanum and myrrh.]

[2] [In prescriptions, about twenty cents a grain in the United States.]

Sulphate of cop
Extract of opi
Confection of r
Useful in hæmorrh

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Guaiacum, o
Opium, half
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Useful in

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[1] [Br. Pha marked : Poison For external use only

[2] [Br. Pha S. Pharm. tincture, which used as a ve (Or about two and a half is three times stronger.)

II

Tincture of aconite, two drachms[1]
Camphor, two drachms
Chloroform, two drachms
Oil of cajuput, two drachms
Alcohol, to six ounces

To be marked: Poison. For external use only

COMPOUND CHLOROFORM

Tincture of opium, two drachms
Tincture of capsicum, half an ounce
Spirit of camphor, one ounce
Ether, one ounce
Chloroform, to four ounces

CHLORAL AND CAMPHOR

Chloral hydrate, one drachm
Camphor, one drachm
Chloroform, two drachms
Sulphuric ether, one drachm
Tincture of opium, one drachm
Oil of origanum, half a drachm
Oil of sassafras, half a drachm
Alcohol, to eight ounces

Triturate the chloral hydrate with the camphor before adding the other ingredients

AMBER

Oil of amber, two drachms
Oil of rosemary, one drachm
Oil of origanum, one drachm
Oil of turpentine, two ounces
Oil of linseed, to four ounces

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[1] [Equivalent to about forty minims of the U. S. Pharm. tincture.]

OINTMENTS

Compound Belladonna

Belladonna-ointment
Mercurial-ointment
Iodide of potassium-ointment
equal parts

Cocaine

Camphor, one drachm
Hydrochlorate of cocaine, ten grains
Oil of bergamot, two minims
Zinc-ointment, three drachms
Lanolin, three drachms

Cocaine and Menthol

Hydrochlorate of cocaine, five grains
Menthol, ten grains
White petrolatum, one ounce

Oleate of Zinc

Oleate of zinc, two drachms
Oil of verbena, one minim
Lanolin, to an ounce

Compound Zinc

Oxide of zinc, one drachm
Calamine, one drachm
Subcarbonate of bismuth, three drachms
Glycerin, three drachms
Carbolic acid, forty minims
Oil of rose geranium, three minims
Lanolin-ointment, to two ounces

COMPOUND SULPHUR

Precipitated sulphur, two drachms
Carbonate of potassium, one drachm
Vermilion, two grains
Oil of bergamot, two minims
Benzoated lard, one ounce

STORAX

Prepared storax, two drachms
Lard, one ounce

BORIC ACID

Boric acid, half a drachm
Powdered arrowroot, one drachm
Cold-cream, one ounce

CALAMINE

Calamine, two drachms
Oxide of zinc, half a drachm
Oil of lavender, two minims
Lanolin, half an ounce
White petrolatum, half an ounce

DERMATOL

Dermatol, two drachms
Oil of neroli, two minims
White petrolatum, one drachm
Lanolin, to an ounce

OIL OF CADE

Oil of cade, half a drachm
Camphor, five grains
Nitrate of mercury-ointment, to an ounce

For chronic eczema and psoriasis

β NAPHTHOL

β Naphthol, ten grains
Camphor, ten grains
Tar-ointment, one ounce

For chronic eczema, psoriasis, and lupus

ALKANET

Crushed alkanet root, fifteen grains
Otto of rose, two minims
White wax, four grains
Lard, one ounce

CALENDULA

Tincture of calendula, three drachms
Lanolin-ointment, one ounce

This preparation, made from the common marigold, is an excellent application for indolent ulcers and for broken chilblains

INJECTIONS

CHLORIDE OF ZINC

Chloride of zinc, ten grains
Glycerin, one ounce
Acetate of morphine, two grains
Water, to four ounces

For urethral injection. To be marked : Poison

BISMUTH

Subcarbonate of bismuth, forty grains
Acetate of morphine, two grains
Rose-water, to four ounces

For urethral injection. To be marked : Poison

"BROWN-INJECTION"

I

Sulphate of zinc, half a drachm
Acetate of lead, one drachm
Powdered catechu, one drachm
Tincture of opium, one drachm
Elderflower-water, to four ounces

For gonorrhœa and gleet

II

Acetate of lead, twelve grains
Acetate of zinc, twenty-four grains
Tincture of opium, a drachm and a half
Tincture of catechu, fifty minims
Powdered gum acacia, a drachm and a half
Elderflower-water, two ounces
Rose-water, to six ounces

For chronic urethritis

LEAD AND OPIUM

Sulphate of zinc, fifteen grains
Acetate of lead, half a drachm
Extract of opium, five grains
Tannic acid, two grains
Rose-water, to four ounces

ALUM AND ZINC SULPHATE

Alum, one drachm
Sulphate of zinc, one drachm
Permanganate of potassium, one grain
Heliotropin, one grain

To be dissolved in a pint of tepid water and used as a vaginal douche

GARGLES

CAPSICUM

Tincture of capsicum, three drachms
Diluted nitric acid, three drachms
Infusion of red gum, to twelve ounces

CHLORATE OF POTASSIUM

Chlorate of potassium, twenty-five grains
Diluted acetic acid, half a drachm
Syrup of raspberry, half an ounce
Water, to ten ounces

BORAX

Glycerin of borax, six drachms
Tincture of myrrh, one hundred minims
Cologne-water, half a drachm
Water, to six ounces

TANNIC ACID

Tannic acid, a drachm and a half
Glycerin, half an ounce
Compound infusion of rose, to four ounces

CARBOLIC ACID

Carbolic acid, ten minims
Chlorate of potassium, two drachms
Glycerin, one ounce
Water, to four ounces

PHYTOLACCA

Tincture of phytolacca, four drachms
Carbolic acid, ten minims
Diluted acetic acid, two drachms
Tincture of myrrh, one drachm
Cologne-water, two drachms
Water, to eight ounces

For the catarrhal laryngitis of singers and public speakers

INHALATIONS

CUBEB

Oil of cubeb, half a drachm
Oil of lemon, ten minims
Light carbonate of magnesium, twenty grains
Water, to an ounce

A teaspoonful in a pint of water, at 140° F.; the vapor to be inhaled for ten minutes

BENZOIN

Compound tincture of benzoin, one ounce

A teaspoonful in a pint of water, at 140° F.
Sedative in acute pharyngitis and laryngitis

CONIUM

Dried carbonate of sodium, twenty grains
Water, at 140° F., twenty ounces

Dissolve, and add conium juice, two drachms
Sedative

MYRTLE AND JUNIPER

Oil of myrtle, ten drops
English oil of juniper, twenty drops
Light carbonate of magnesium, twenty grains
Water, to an ounce

A teaspoonful in a pint of water, at 140° F.
For acute tonsillitis and vocal weakness

SAGE AND THYME

Oil of sage, ten minims
Oil of thyme, five minims
Oil of neroli, two drops
Light carbonate of magnesium, ten grains
Water, to an ounce

A teaspoonful in a pint of water, at 140° F.
Stimulant

MENTHOL AND BENZOL

Menthol, eight grains
Benzol, forty minims
Chloroform, five minims
Oil of cassia, two minims
Light carbonate of magnesium, twenty grains
Water, to an ounce
A teaspoonful in a pint of hot water for each inhalation

CREASOTE

Creasote, forty minims
Tincture of quillaia, ten minims
Water, to an ounce
A teaspoonful in a pint of hot water for each inhalation

THYMOL

Thymol, six grains
Alcohol, one drachm
Light carbonate of magnesium, five grains
Water, to an ounce
A teaspoonful at [illegible]° F.
Stimulant and disinfectant

FUMING INHALATIONS

I

Powdered anise, one ounce
Powdered stramonium leaves, two ounces
Powdered sumbul root, one drachm
Powdered nitre, one ounce
To be thoroughly mixed
A portion of above to be ignited and the fumes inhaled

II

Powdered fennel, one ounce
Powdered stramonium leaves, one ounce
Powdered black tea, one ounce
[illegible] of potassium, one drachm
[illegible] of potassium, one ounce

III

Powdered stramonium leaves, one ounce
Powdered cascarilla, one ounce
Powdered frankincense, two drachms
Powdered myrrh, two drachms
Powdered nitrate of potassium, one ounce and a half

SOLUTIONS FOR ATOMIZING

I

Terebene, two drachms
Oil of sandal-wood, one drachm
Oil of cubeb, one drachm
Oil of lemon, one drachm
Parolein, to two ounces

To be used in an atomizer or nebulizer for chronic bronchitis and emphysema

II

Hydrochlorate of cocaine, ten grains
Menthol, one drachm
Camphor, one drachm
Liquid paraffin, to four ounces

A mild anæsthetic for the nose, throat, and adjacent parts

III

Guaiacol, one drachm
Oil of eucalyptus, half a drachm
Oil of gaultheria, one drachm
Oil of cassia, one drachm
Firwood-oil, one drachm
Liquid paraffin, to four ounces

Used in cases of phthisis, as an antiseptic

Menthol,
Benzol, f
Chlorofor
Oil of cas ...ces
Light ca ...ve fluidounces
Water, ...ces
A teaspoonfu ...llons

Creaso ...ounces
Tinctu
Water, ...llons
A teaspoon

Thym
Alcoh
Ligh ...ces
Wat ...gallons
A teasp
Stimula

Po
Po
Po
P
To be
A dra

...cloth ...then ... water ... to 100° F.

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BATHS

NITROHYDROCHLORIC ACID

Nitric acid, fifteen fluidounces
Hydrochloric acid, twenty-five fluidounces
Aromatic vinegar, four ounces
Water, at 90 ° F., thirty gallons

ALKALINE

Bicarbonate of sodium, four ounces
Oil of bergamot, ten drops
Water, at 95 ° F., thirty gallons

SIZE

Clarified size, six pounds
"Florida-water," four ounces
Boiling water, one gallon
Water, at 98° F., to thirty gallons

SALT

Bay salt,[1] ten pounds
Bay rum-essence, one drachm
Water, thirty gallons

BRAN

Wheat bran, four pounds
Water, thirty gallons

Tie the bran in a muslin [or cheese-cloth] bag, macerate it for ten minutes in water, at 185 ° F., then add more water till the temperature of the bath is 95 ° to 100 ° F.

[1] [From sea-water.]

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The doses given are the customary maximum single doses for adults.

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[1] Not *Sedatin* = valeryl-phenetidine.

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